AVIATION WEEK

A McGRAW-HILL PUBLICATION

OCT. 31, 1955

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In answer to the airman's emergency distress signal, "Mayday, Mayday", the Albatross has grown from a speck to a queen to many a man marooned in a dinghy or on an icecap. Flown by skilled crews of the U. S. Air Force, Air Rescue Service, the U. S. Navy and Coast Guard, the Grumman Albatross can land and take off from snow and ice, as well as land and sea. Though she doesn't fit into the airman's survival kit, she's part of it.

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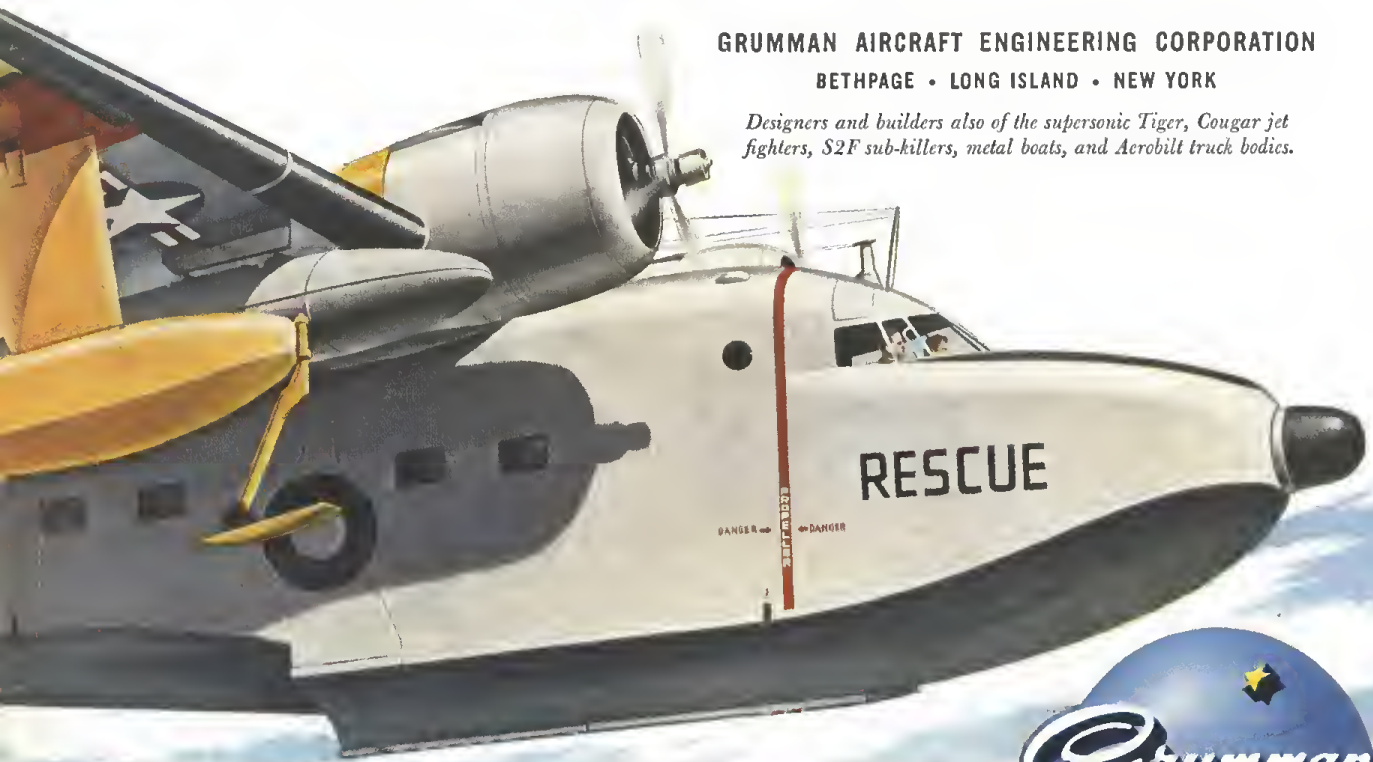

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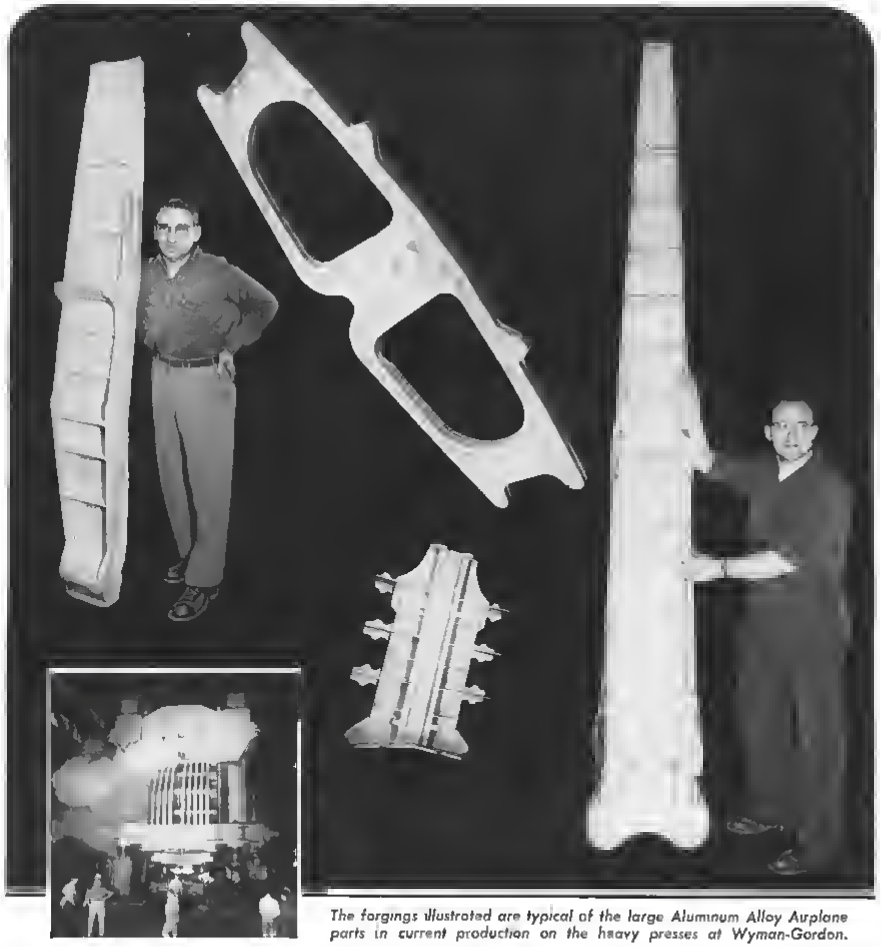

The forgings illustrated are typical of the large Aluminum Alloy Airplane parts in current production on the heavy presses at Wyman-Gordon.

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NEWS DIGEST

New Look for YH-16A

PIASECKI'S ganging YH-16A helicopter has been equipped with anhedral tail surfaces and vertical fins. This aircraft had been fitted with conventional horizontal surfaces. YH-16A shown here is being readied for flight testing.

Roger Lewis Joins Pan American Airways

Roger Lewis, recently retired Assistant Secretary of the Air Force for Material, joined Pan American World Airways as executive vice president in charge of the airline's development and defense projects.

Lewis' duties will include:

- **Supervision of Pan American's** airline-aid program in Pakistan and Turkey under the auspices of the economic cooperation administration.
- **Administration of** the civil reserve Air Force program.
- **Operation** (under Defense Department sponsorship) of a missile test range off the coast of Florida.

A former vice president of the Curtiss-Wright Corp. and of Canadair Ltd., in Montreal, Lewis entered Air Force service in March, 1953, and retired last Sept. 30.

Domestic

A completely transistorized airborne digital computer, the first of its kind to reach the flight test stage, has been developed by North American Aviation's Electro-Mechanical Division. Although NAA failed to reveal the computer's intended function it presumably could be used as an interceptor fire-control-and-navigation computer. The unit weighs only 125 lb., occupies 3 cu. ft. of space and consumes 93 watts power (1/30 as much as a corresponding computer using tubes).

Fifth Forrestal class super carrier will be built for the Navy by the New York Shipbuilding Corp., Camden, N. J. Contract cost will be $119,841,034 including new graving dock.

Two veteran test pilots, Holland's Lt. Col. Gerben Sonderman, and Canada's Gleudon Joseph Lynes, lost their lives during October. Sonderman, 47, chief pilot for Fokker Aircraft and personal pilot of Prince Bernhard, was killed near Hagerstown, Md., while flying Fokker's S-14 two-place jet trainer before officials of the Fairchild Aircraft Corp. The trainer (Fairchild has its U. S. production rights) failed to pull out of a spin and crashed onto a farm. On the same day, Lynes, 36, test pilot for Avro Aircraft Ltd., in Toronto, was killed after ejecting from an out-of-control CF-100 Mark 4 twin-jet interceptor. Officials said the plane apparently was too low at the time. Lynes, a former pilot for Canadair Ltd., joined Avro approximately one year ago.

The 1,112th, and last, Air Force C-119 flying Boxcar is scheduled to roll off Fairchild Aircraft Corp.'s Hagerstown, Md., production line today.

Financial

General Electric Co. last week reported a near-record sales figure for the nine months ending Sept. 30. Registering the second best three-quarter-year period in its history, General Electric had total sales of $2,245,958,000, a 4% increase over the $2,167,397,000 for the same period of 1954. Earnings also were up 4%: $141,359,000 ($1.63 per share) as compared with 1954's $136,191,000 ($1.57 per share). During the nine months defense product sales were down somewhat as "anticipated" but commercial sales established a new record.

Foreign

The Hawker Hunter was restricted to maximum accelerations of four Gs at altitudes below 10,000 ft. after an RAF pilot on maneuvers in Germany blacked out during a turn at about 10,000 ft. His Hunter tightened the turn to an estimated 12Gs, the pilot recovered at 2,500 ft. and returned to base. Inspection showed that both wings and the port side of the fuselage were buckled by the violent maneuver. London Daily Express says the Air Ministry ordered the restriction, a Ministry spokesman was quoted as saying that sharp maneuvers may affect the Hunter's trim, causing tightening in turns.

as others see us . . .

A user tells how AETCO SERVICE helped him

—by Harry E. Smith
Vice President
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AVIATION CALENDAR

Nov. 3-4—Institute of the Aeronautical Sciences and Canadian Aeronautical Institute second annual joint meeting, Chateau Laurier, Ottawa Ont. Canada.

Nov. 6-9—24th Annual National Conference of the Controllers Institute of America, Hotel Statler, Los Angeles. Robert E. Gross, president of Lockheed Aircraft Corp., will speak on "The Future of Aircraft."

Nov. 8-10—National Aviation Trades Assn. annual convention, Hotel Westward Ho, Phoenix, Ariz.

Nov. 9—Institute of the Aeronautical Sciences, Dayton Section meeting, Miami Hotel, Dayton, Ohio. Brig. Gen. Thomas L. Bryan will deliver a talk on "Decision for Air Progress."

Nov. 9-10—Society of Automotive Engineers Golden Anniversary Fuels & Lubricants Meeting, Bellevue-Stratford Hotel, Philadelphia.

Nov. 9-11—Industrial Management Society, 19th annual time motion study, management clinics, Hotel Sherman, Chicago.

Nov. 13-18—American Society of Mechanical Engineers Diamond Jubilee Annual Meeting & American Rocket Society 25th Annual Meeting, Congress, Hilton and Blackstone Hotels, Chicago. Nov. 14—ASME Aviation Div. Meeting.

Nov. 14-15—Aviation Distributors & Manufacturers Assn., 26th meeting, El Mirador Hotel, Palm Springs, Calif.

Nov. 14-17—Second International Automation Exposition, Navy Pier, Chicago.

Nov. 16-18—Society for Experimental Stress Analysis, annual meeting, Hotel Sheraton, Chicago.

Nov. 21-22—Symposium on Aeronautical Communications—Civil and Military, sponsored by Institute of Radio Engineers, Hotel Utica, Utica, N. Y.

Nov. 25—Convertible Aircraft Pioneers, Third National Congress (invitation only), Franklin Institute, Philadelphia.

Dec. 2-3—Eighth Annual Aviation Conference & Flight Clinic, sponsored by Tucson Chamber of Commerce and Tucson Airport Authority, Tucson, Ariz.

Dec. 6-7—Professional Race Pilots Assn., convention, Carter Hotel, Cleveland.

Dec. 12-17—Nuclear Congress and Atomic Exposition, sponsored by Engineers Joint Council, Cleveland.

Dec. 15-17—Fall Meeting, USA National Committee, URSI (International Radio Scientific Union), University of Florida, Gainesville, Fla.

Jan. 9-10—Second National Symposium on Reliability and Quality Control in Electronics, sponsored by Institute of Radio Engineers, Hotel Statler, Washington, D. C.

Jan. 9-13—Society of Automotive Engineers Annual Meeting, Sheraton-Cadillac and Statler Hotels, Detroit.

Jan. 19-21—National Simulation Conference sponsored by Dallas-Fort Worth Chapter of Institute of Radio Engineers Group on Electronic Computers, Dallas, Tex.

Jan. 23-26—Plant Maintenance & Engineering Show and Conference, Convention Hall, Philadelphia.

PICTURE CREDITS

7—Levy Sommerich, 13, 14—Wide-World, 31—Howard Levy.

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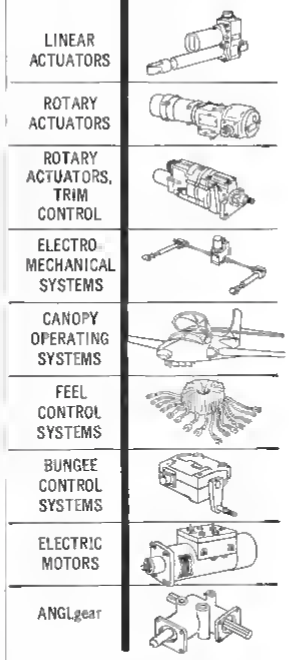

The postwar era of progress from sonic to supersonic flight has produced almost daily changes in aircraft technology. The Airborne products illustrated were all originated in that era—and are continuously being improved to keep abreast of these changes. Entirely new products are constantly being developed, too. If none of these meets your requirements, we can design one that does — and we want to. Write for our new Aviation Catalog today.

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WHO'S WHERE

In the Front Office

Sir Roy H. Dobson, board chairman of A. V. Roe Canada Ltd., Toronto, board chairman of Canadian Car & Foundry Co. Ltd., Montreal. **Crawford Gordon, Jr.**, president-general manager of A. V. Roe Canada Ltd., CC&F vice chairman. **Sir Frank Spencer Spriggs**, managing director of the Hawker Siddeley Group, a director. **E. J. Costord** remains president of Canadian Car & Foundry.

John H. Harris, vice president planning, Brush Electronics Co., Div. of Clevite Corp.; **Wallace T. Gray**, general works manager. **J. Kneeland Nunan**, former president of Consolidated Vacuum Corp., vice president general manager of Clevite Research Center.

A. Eric Theis, vice president-manufacturing of Servo Corporation of America. Also promoted: **Charles F. Healey**, vice president administration, **H. Gordon Hawthorne**, treasurer.

William P. Maginnis, president of Kuthe Laboratories, Inc., Newark, N. J., subsidiary of International Telephone & Telegraph Corp.

John W. Barry, vice president of Wallace Clark & Co., Inc., management consultants to airline and aviation industry. **Robert Galloway** and **Robert B. Wilson**, assistant vice presidents.

George W. Baughman, vice president of Union Switch & Signal Div. of Westinghouse Air Brake Co., appointed to the staff of A. M. Wiggins, vice president-general manager, and was not appointed general manager as reported in this column on Oct. 17.

Honors and Elections

Prof. John R. Markham, professor of aeronautical engineering and director of supersonic wind tunnel at Massachusetts Institute of Technology. **Dr. W. Randolph Lovelace II**, director of Lovelace Foundation. **Dr. Robert H. Kent**, asst. director of ballistic research at Aberdeen Proving Ground, and **Cdr. Richard Soderberg**, Dean of the School of Engineering at MIT, were presented with Exceptional Service Awards at a meeting of the Air Force Scientific Advisory Board.

Willis C. Brown, U. S. Office of Education, recipient of 1955 Frank G. Brewer Trophy, highest award in the field of youth aviation education, administered by the National Aeronautic Assn.

Charles S. Weaver, vice president-atomic power activities of Westinghouse Electric Corp., received 1955 National Transportation Award at the Tenth Annual Convention of the National Defense Transportation Assn.

Changes

Vice Adm. Charles Frederick Coe (USN Ret.), former director of Air Warfare Div., Office of Chief of Naval Operations, assistant to the vice president, engineering and military relations at Ryan Aeronautical Co.

(Continued on p. 50)

INDUSTRY OBSERVER

►Lockheed, Boeing and Convair have USAF study contracts for an atomic-powered bomber. Boeing is also developing a chemically fueled bomber proposal using an ethyl borane fuel aimed at producing longer range.

►**Army future equipment will include a reconnaissance drone missile that will transmit a television view of enemy terrain to a hovering helicopter for relay to ground forces. Excessive helicopter vibration is a current obstacle to airborne television reconnaissance.**

►Bell HSL anti-sub warfare helicopter powered by a Pratt & Whitney R2800 piston engine continues to have operational problems. Larger diameter rotor blades will be used in an attempt to increase lift and load-carrying capacity. Meanwhile Bell is planning a transport version of the HSL powered by three gas turbine engines, aimed at carrying 28 to 36 passengers.

►**Now that Lockheed has finalized its Electra turboprop transport design watch for a big sales campaign in Europe that will cut deeply into the Vickers Vanguard and Bristol Britannia prospects.**

►North American Aviation may set up its Electro-Mechanical Division, one of the nation's largest avionics groups, as an autonomous group and possibly under a different name, within the near future. Speculation is spurred by NAA's recent action in setting up its nuclear activities as a separate group, under the name of Atomics International. (AW Oct. 24, p. 7)

►**An inflight refueling system to transfer jet fuel from one fighter's tanks to another is being developed for the Chance Vought F7U-3. The Cutlass "Buddy System," which should increase the fighter's range considerably, is being designed and manufactured by the Schulz Tool and Mfg. Co., of San Gabriel, Calif. (AW Aug. 15, p. 53), to Chance Vought specifications.**

►Shop production of Lockheed's 1649 thin-wing transport started last week in the first completed major tooling assembly—a gantry jig for the wing beam of the new plane. Lockheed has scheduled the 1649 to fly sometime in October 1956.

►**General Motors Corp. interest in acquiring Nuclear Development Corp. indicates the Allison Division probably will get into the atomic aircraft propulsion picture.**

►Sabena, Belgian national airline, will recommend to its directors that eight Sikorsky S-58 transport helicopters be purchased for various interurban operations.

►**United Aircraft Corp.'s engineering vice-president Leonard S. Hobbs speculates that the big Russian axial flow turbojets powering the Bison and Badger bombers are in the 15,000-18,000 lb. thrust category, use a single spool compressor, have a relatively low compression ratio (about 7 to 1), operate at relatively low turbine inlet temperatures and have a relatively high fuel consumption.**

►Sikorsky H-34 (S-58) helicopter powered by a Wright R1820-84 engine has exceeded Army expectations in service tests. H-34 gross is now up to 13,300 lb.

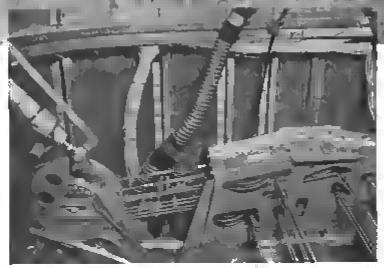
►**USAF's Bomarc (IM-99) long range interceptor missile will use guidance and control equipment now under development by Westinghouse Electric Corp. at its Baltimore Air Arm and Electronics Divisions. Boeing Airplane Co. is the prime contractor for the Bomarc.**

►No very marked improvement in shielding materials for aircraft nuclear powerplants seems likely in the near future. Capabilities of present materials are well known and the only hope for great improvement lies in the "discovery of some completely new physical principle, such as would merit the Nobel Prize," according to informed sources.

First light twin to use supercharged engines has "Hi-Fatigue" Cable installations!

New Aero Commander 680 Super, by Aero Design and Engineering Company. This new executive plane carries 6-7 passengers, cruises at 230 mph.

NEW AERO COMMANDER 680 SUPER!



Interior view showing "Hi-Fatigue" control cable installation in the Aero Commander 680.

The Aero Commander 680 Super is the first light twin-engine executive plane to offer supercharged performance. The new model has a useful load capacity of 2,750 lbs., a single-engine ceiling of 15,000 feet, a cruising speed of 230 mph., and a one-stop, coast-to-coast range. The Aero Commander 680 is equipped with Macwhyte "Hi-Fatigue" control cable.

"Hi-Fatigue" control cable is widely used by leading manufacturers. A complete line of sizes and types is supplied in Galvanized, Tinned, and Stainless Steel. "Safe-Lock" Terminals for swaging may be purchased loose or attached. Macwhyte Aircraft Products meet the requirements of aircraft manufacturers, airlines, and military specifications.

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Washington Roundup

What Will Sagebrush Prove?

Watch for both Army and Air Force to utilize performance of air units in this month's Operation Sagebrush to support their viewpoint in snowballing argument over control of aircraft. Planes taking part in 45-day joint maneuver across Louisiana will include USAF F-100 and F-84F fighters, B-57 tactical bombers in tactical operations, light planes and helicopters flown by Army in the combat area. Reports from field will be used by USAF to show Tactical Air Command can and does give proper support to ground forces possibly is impeded in mission by Army balloons" hovering and buzzing around target areas. Army, contrariwise, will be seeking evidence to prove they need control of TAC as well as aircraft of higher speed, longer range. Real showdown will come when 1957 budget figures are presented.

Taal Program Dead?

Shrouded in face saving language, Defense Department is expected to announce soon that the reserve tool program is dead. About $150 million of Fiscal 1955 and 1956 money will be returned to the Treasury, thereby helping the administration balance the budget. Funds include about $50 million unobligated by the services out of 1955 money and $100 million for current year that Defense never earmarked for individual services.

More Pressure for IFR

As a result of Trans World Airlines experience operating all of its flights under instrument flight rules, the executive committee of the Air Line Pilots Association is considering recommendations that all major airlines follow TWA's lead. Although all IFR operations by the airlines would cut traffic flow radically it would also provide a more realistic measure of the air traffic control load, highlight operational bottlenecks and provide more safety. Airline concern over the mid-air collision problem during mixed VFR and IFR traffic conditions is increasing.

CAB Goes to School

The Civil Aeronautics Board has developed a new policy designed to make its staff members more familiar with actual airline operations. Under the plan, the CAB will authorize airlines to provide free transportation to selected staff members for inspection trips which are supposed to give them a first-hand knowledge of airlines they can't get sitting behind a desk in Washington. CAB personnel will travel on a space-available basis and will be paid the standard per diem allowance by the Board.

United Air Lines will furnish transportation for the first trip. Twelve members of the CAB staff will travel to Chicago, Denver and San Francisco to inspect airline installations. The Board has asked an exemption to United, which expires Dec. 31, 1955, to provide free transportation to the group, and the trip is scheduled for early November. Several other airlines are reported interested in the program.

CAB member Chan Gurney dissented on the new policy. He expressed doubts on the legality of the exemption and said he felt strongly that it is an unwise Board policy to permit the carriers under CAB jurisdiction to provide free transportation for CAB personnel.

If critics of the CAB—and there are many both in Congress and elsewhere—should use the new policy to attack the Board, it could backfire. Apparently the CAB figures the benefits of the program outweigh its potential dangers.

CAA Changes Loom

Proposal for a major realignment of functions within the Civil Aeronautics Administration will get a decision soon. Commerce Under Secretary Louis S. Rothschild has the plan but gave Fred B. Lee, CAA Administrator, two weeks grace to register his objections. Lee is specifically objecting to the separation of air traffic control functions from the Office of Federal Airways and the establishment of a separate, independent ATC operation. Lee had no hand in the preparation of the new plan. His opposition to its adoption is expected to result in a showdown with Rothschild.

Inadequacies of the present ATC system and the need for future system planning are now of paramount interest in Rothschild's office as a result of combined military and airline pressure.

Rothschild told AVIATION WEEK that he expected a decisive course of action to be charted in the very near future by the Air Co-ordinating Committee. "We must and we are going to get off dead-center with the air traffic control problem," he said.

In seeking positive action, Rothschild indicated that certain internal changes may have to be made at CAA but denied there is a major reorganization in the offing. He emphasized that he foresees nothing like a reorganization of the agency but rather that he thought some realignment of functions involving management changes would suffice.

Rothschild said that the first step towards improving air traffic control in the future would come from a five-year CAA airways program. The CAA plan is reported to involve expenditures of $500 million in the next five years. Rothschild said a firm budget figure would not be available until after discussions of CAA's budget for fiscal year 1957 with the Bureau of the Budget.

Industry-Wide Investigation

All aircraft manufacturers are being invited to executive sessions with the House Armed Services Investigating Subcommittee, scheduled for the second week of November. This is prelude to public hearings. The subcommittee staff has reviewed and investigated company replies to 35 questions. Company representatives at the closed session will be given an opportunity to present their position on aspects of Air Force and Navy procurement the subcommittee plans to develop at public hearings. The subcommittee investigation is across the board, dealing with procurement policies applying to all manufacturers.

ATC Study Continues

Shortcomings of the air traffic control system today and not what the system requirements might be 20 years from now has been the number one complaint registered with the Budget Bureau's Harding Committee investigating the need for a long range study. Slated to report by Nov. 1, the Harding Committee has been granted a short extension to complete its work. —Washington staff

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BuAer Admits, Defends Error on Demon

$200 million Navy jet program was calculated risk, Admiral Russell says; J40 engine held inadequate.

By Katherine Johnsen

Bureau of Aeronautics staunchly defended the calculated risk it took on the F3H-1 Demon program, costing the government $200 million, but conceded that on hindsight it was "in error," at hearings before the House Military Operations Subcommittee.

"Whoever made the decisions was right, but time proved him wrong," Rear Adm. James S. Russell declared. He said that if he had been BuAer chief at the time, he would have made "exactly the same decisions" as were made on the Demon program.

Evidence showed that this is the fate of the 60 planes involved, produced by McDonnell Aircraft Co. and powered with the J40 engine of Westinghouse Electric Co.

- **Five were lost** in crashes, killing four pilots. There was a total of 11 crashes in testing.
- **Twenty-five will never be flown** because of the unreliability of performance, and will be used for ground testing. Four have already been shipped to naval bases. Twenty-one will be shipped by trailer through St. Louis and then on barges to the Naval Air Technical Training Center at Memphis, Tenn.
- **Four have been developed** as prototypes powered with the Allison J71. There have been three crashes in testing. Whether to backfit the remaining 26 aircraft with J71s is now up for decision by an independent naval board. Estimated cost of the backfitting varies widely. The high estimate is $450,000 per plane. If backfitted, the planes would be used for flight training.

The Navy also has not yet made a decision on what to do with 174 J40s it has on contract, eleven of which have not been delivered.

This is how the $200 million program is divided:

- **Cost of the engine program,** $107 million. This includes research, development, production, spare parts and termination charges. The termination payment to Westinghouse is estimated at $10 to $15 million. A $15 million termination payment was made to Ford Motor Co., which tooled up to produce the J40, but never did.
- **Cost of the aircraft program,** $91 million. This includes $78 million for aircraft produced by McDonnell, a $4 million termination payment to McDonnell, a $330,000 termination payment to Goodyear Aircraft Co., and a $9 million termination payment to Temco Aircraft Co. Goodyear and Temco tooled up but never produced F3H-1s.

These costs totaling $200 million do not include the $50 million plant at Romulus, Mich., built for production of the J40 by Ford. The plant is now a part of Navy's industrial mobilization reserve.

The House hearing was called at the request of Rep. Frank Karsten (D.-Mo.). Meanwhile, an investigation of the same program by the Senate Preparedness Investigating Subcommittee, requested by Sen. Stuart Symington (D.-Mo.), is continuing.

The perennial problem of the calculated risk of the bold approach in aircraft procurement, as opposed to the cautious approach, which might save money but would risk the U.S. airpower position, figured in the hearings.

Will Revise Test Plan

Now faced with orders from the Defense Department to speed up aircraft production, Admiral Russell said that he believed that this could be accomplished without a recurrence of the $200 million Demon project.

The Navy, he said, would recommend a compression—but not an abandonment—of its "TRIM" policy, the Navy's counterpart to the Air Force's "fly before you buy" policy. He recommended two alterations in "TRIM": more prototypes of a given model and more models of developmental aircraft.

"You should have about three companies go right up through the prototype, build, and fly three different types," he said. "Then you can select one to put into production."

Calling for more prototypes of each model, he explained: "We now make one static test article. If the static test article is loaded up and the wing breaks off, we need a second airplane to put right in there to find out where the load is that it will stand."

The basic cause of the failure of the Demon program, as outlined at the hearings was this: The J40-22 was adequate for the requirements of the original F3H-1 version, designed as a short range interceptor. The Navy directed a modification of the plane to a longer-range all-weather fighter on the anticipation of a higher-thrust version of the J40, the J40-24. The modification increased the weight of the plane from 22,000 lbs. to 29,000 lbs. The higher-thrust J40 failed to materialize, never passing beyond the developmental stage, and the J40-22 was installed in the F3H-1.

There is general concurrence that the reason for the failure of the F3H-1 is the inadequacy of the engine to support the airframe weight.

Key points dealt with at the hearings were:

- **Whether Westinghouse** was given "favored" treatment, both in the delay in the cancelation of the J40s and in the terminations, which were made "at the convenience of the government, rather than by default."
- **Charges of negligence** on the part of McDonnell in the handling of J40s, and other engines, which were government furnished equipment.
- **The role of Rear Adm. Loyd Harrison** as Deputy Chief of BuAer from September, 1952 to July 1, 1955, and as vice president for procurement of McDonnell since Aug. 1, 1955.

Holifield Protests

Rep. Chet Holifield (D.-Calif.), chairman of the subcommittee, protested that on the Westinghouse and other contracts to big firms the Navy "always finds ways to give them favorable treatment." He said that small business firms have their contract canceled by "default" when they fail to meet delivery dates and performance requirements. BuAer witnesses explained the delay in cancelation of the J40s was the hope that eventually it would be a success.

It was developed that as early as July, 1951, McDonnell recommended a substitution for the J40, proposing the J47 of General Electric Co., and that again in April, 1952, it urged substitution, recommending the J71. Navy did not decide on the substitution until November, 1952.

Substitution Decision

The committee counsel said that there were 564 J40s on order in the spring, 1953, after the substitution decision had been made, Admiral Russell put the figure at 477. The initial reduction in J40 development and production did not take place until September, 1953, when the order was reduced to 107 production engines and development of the higher-thrust J40-24 version was cancelled. The final cancelation was not made until July, 1955, after the death of a McDonnell test pilot, and pilots indicated they would refuse to fly the plane, if it were not grounded by the Navy, which it was.

Two BuAer representatives in October, 1954, and again in June, 1955, protested to headquarters on negligence on the part of McDonnell in the handling of engines and the entrance of "foreign particles" which might effect performance.

In October, Capt. C. H. S. Murphy pointed to "grave deficiency" on the part of McDonnell, called for "extraordinary action," and recommended a fine of $25,000.

In June, Capt. C. Park Sager, protested "excessive damage" to J40s and other engines at McDonnell, called it "an alarming condition," demanded immediate action. He said that there was a deplorable waste of government funds, manpower, and time." He proposed that this be considered in redetermination on McDonnell contracts.

H. Carroll Moore, McDonnell manager, however, insisted that the company has taken vigorous steps to prevent engine damage through increased inspections, flood lighting, indoctrination of employes. He said that he made an inspection of five other aircraft companies and found they had the same problem on engine care. McDonnell will fight any financial penalty for failure in engine care.

Harrison's Testimony

Rear Adm. Harrison testified that he did not recall specifically dealing with any McDonnell procurement, termination, or other contracts during his service at BuAer, but added that "all contracting paper over $300,000 came to me routinely for review." He was specifically asked about the termination on the F3H-1 in November, 1954, when the contract was cut back by 248 aircraft, leaving 280 F3Hs on order, 60 of which were the F3H-1 version.

Harrison said that he was approached by J. S. McDonnell, president of the company, in March, and promptly on retirement, requested of the Secretary of the Navy, became vice president for procurement of the company. He said that his duties were to deal with the over 2,000 subcontractors, and that he had no business dealings of any kind with BuAer.

Key Dates in the F3H-1 and J40 History

June, 1947—Navy authorized Westinghouse Electric Co. to proceed with the design of the J40 engine.

December, 1948—Navy placed a development contract for the J40 on Westinghouse's promise of delivery of one version (—8) by September, 1950, and an advanced version (—10) by July, 1951.

July, 1949—McDonnell Aircraft Co. was awarded a letter of contract for two experimental F3H-1s, to be designed as short range interceptor fighters and powered with the J40-8, after winning a competition in which seven manufacturers participated.

January, 1951—Navy decided to modify the F3H-1 to a longer range, general-purpose all-weather fighter, increasing the plane weight by almost 10,000 lbs.

March, 1951—A production contract for 150 of the new version of the F3H-1s, to be powered with the J40-10, was placed. Shortly this was increased to 525 aircraft, and a contract for an additional 100 was placed with the Goodyear Aircraft Co.

July, 1951—Concerned over deliveries of the J40, McDonnell dispatched a letter to the Bureau of Aeronautics suggesting five substitute engines and recommending the J47-2 of General Electric Co. for the F3H-1. BuAer took no action on the recommendation.

August, 1951—Initial flights of the XF3H-1 showed troubles with the J40, but these were not considered "seriously out of line."

March, 1952—The Goodyear contract was canceled, and an order for 160 F3H-1s was placed with Temco Aircraft Corp.

April, 1952—McDonnell again expressed concern over the J40 engine to BuAer and recommended substitution of the J71 built by Allison Division of General Motors Corp.

June, 1952—Navy turned down the recommendation because of the cost involved.

November, 1952—Navy reversed itself and decided on the J71 substitution, shortly after the flight rating test of the engine. It was decided that airframe changes to suit the F3H-1 to the J71 should start with the 61st plane.

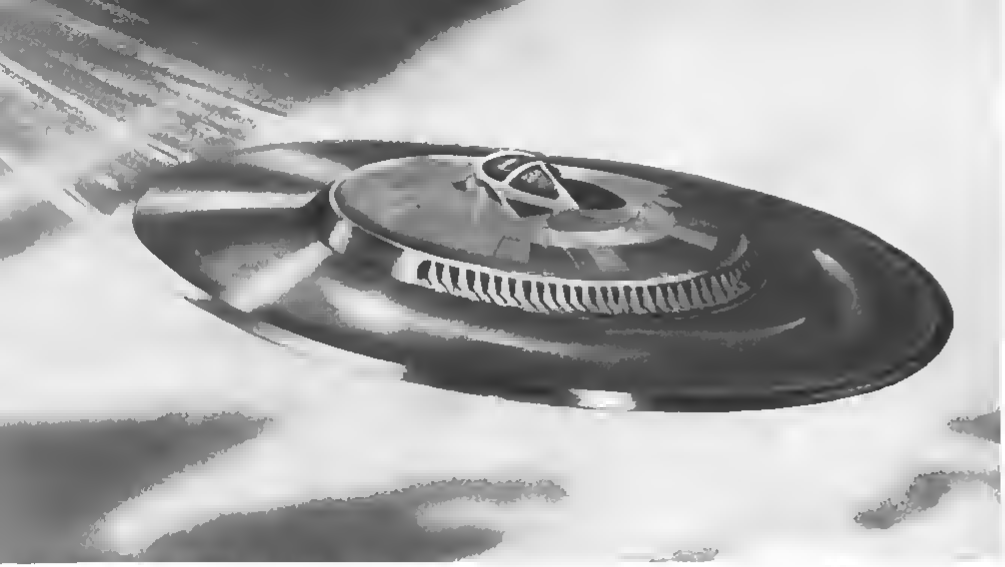
December, 1952—Testing of the F3H-1 production models powered with the J40 gets underway.

June, 1953—Temco contract canceled.

September, 1953—Discouraged with progress, the Navy canceled developmental work on the J40-10, and decided to take deliveries on the J40-22, the production version of the J40-8, up to the minimum required for the requirements of the 60 F3H-1s, including testing and pilot training programs.

July, 1955—Fourth pilot was killed in flight testing of the F3H-1 and the Navy banned flight operations of the plane. Production of J40s was further reduced, still leaving 174 under contract, 11 of which have not yet been delivered.

NAVY SPOKESMEN, Raymond Fogler, Assistant Secretary for Materiel, and Rear Adm. James S. Russell, Chief of BuAer, explained Navy's version of Demon "mistake."



DEFENSE DEPARTMENT artist's drawing of a flying saucer such as one that could evolve from the USAF's Canadian project.

USAF Confirms Avro Saucer Project

Washington—The U S Air Force last week denied that flying saucers exist, but said they soon will

USAF Secretary Donald A Quarles confirmed that the previously announced development contract with Avro Aircraft Ltd, of Canada (AW Aug 29, p 13) "could result in a disc-shaped aircraft somewhat similar to the popular concept of a flying saucer"

The Avro project was taken over by USAF's Air Research and Development Command after the Canadian government had spent $397,000 on the design It was estimated by Canadians that about $100 million would be needed to build a prototype.

How Saucer Evolved

Avro Aircraft's flying saucer project is based on model studies of a true disc configuration Initial investigations established that flight control of the disc could be achieved through directional control of the jet exhaust issuing from a gap between the upper and lower disc surfaces, inboard of the saucer perimeter

This exhaust directed up, down or laterally from the perimeter by control of the exhaust gap dimensions would produce the Coanda effect—bending of the jet stream

With one fixed gap dimension, the flow would be straight out to produce lateral (horizontal) thrust for transitional flight. With the gap precisely altered to another dimensional value,

Coanda Effect

If a jet of gas is discharged adjacent to a surface, the flow tends to follow the wall contour even where the surface curves away from the original jet axis This is particularly true of a flat, two-dimensional jet. By properly curving the surface away from the jet discharge axis, the jet can be induced to turn through angles up to 160 degrees.

One example is the flow through the slot of a slotted flap This jet of air discharges along the upper surface of the movable flap portion, and is deflected downward, away from the flow axis of the slot The airflow through the slot sticks to the flap and contributes to the high lift coefficient obtained.

An example with a detrimental effect is the case of belly mounted jet engines which discharge near the fuselage skin The exhaust tends to follow the fuselage contour, and causes flow problems at the tail

This "sticking" tendency is known generally as the Coanda effect although some sources credit its discovery to British aerodynamicist H B Squire

the exhaust stream bends down or up for vertical thrust effect

For vertical takeoff, the top portion of the gap would be closed and alteration of the gap opening accomplished for downward direction of exhaust flow to lift the saucer vertically

For translational flight, the gap, altered for straight out jet flow and closed on a perimeter portion of the saucer, applies jet thrust on the opposite side of the perimeter

Powerplant

The powerplant for this saucer configuration might be a substantial refinement of an elementary engine scheme associated with an edge-on (almost vertical) takeoff plane design which AVRO had under consideration before it turned to true saucer studies

This plane design, of which only a wooden mockup was built was in effect a D-shaped disc resembling a delta configuration with rounded sides It measured approximately 25 ft in length and 21 ft across and would have accommodated a prone pilot

For edge-on takeoff, the plane was supported by tricycle gear with a very long nose strut to give the disc body an approximately 70 deg angle of inclination

A maximum-size turbojet engine of "pancake" configuration was to be contained within the D-shaped body The rotor for the engine would have been in the form of a disc with blades mounted on either side for radial compression of the periphery of the rotor discs

The inboard end of the rotor disc was to be supported by conventional bearings whereas the outboard section was to be supported by an "air bearing" which also acted as a cooling air film between the rotor and the combustion chambers positioned on either side of it, outboard of the compressor portion. The turbine wheel was to be located at the extreme periphery of the rotor disc

Exhaust gases passing through the wheel would be guided rearward by turning vanes located in front of openings along the side of the D-shaped body A substantial portion of the exhaust gas might be diverted through hollow control surfaces—elevons—at the rear for controllability as well as for additional thrust

Why 'Quarles' Announcement

Secretary Quarles indicated that his announcement of the project was made to offset public concern if a disc shaped aircraft should be spotted He said

"Vertical rising aircraft capable of transition to supersonic horizontal flight will be a new phenomenon in our skies and under certain conditions could give the illusion of the so-called flying saucer The Department of Defense will make every effort within bounds of security to keep the public informed of these developments so they can be recognized for what they are"

The Secretary said the Ryan jet vertical takeoff fighter soon will make its first flight at Edwards AFB, Calif This is a delta wing aircraft (AW Aug 29, p 17) He added

"We expect to develop airplanes that will fly faster, higher and perhaps farther than present designs but they will still obey natural laws and if manned, they will still be manned by normal terrestial airmen

Other than reducing runway requirements we do not expect vertical rising aircraft to have more outstanding military characteristics than conventional types"

The Quarles announcement was geared to USAF release of its investigation of reported sightings of flying saucers The study, under way since 1947, disposed of hundreds of reported flying saucers with the conclusion that they usually are natural objects—balloons aircraft or astronomical phenomena

USAF's evaluation the report said, indicates it is "highly improbable that reports of unidentified aerial objects examined in this study represent observations of technological developments outside of the range of present day scientific knowledge"

First U.S. Nuclear Powerplant May Begin Flight Tests by 1958

By Henry Lefer

This country's first nuclear powerplant may begin flight tests as early as 1958-59, but surely no later than 1965, according to the views expressed by experts at the fourth annual conference on Atomic Energy in Industry held in New York last week.

That there is considerable justification for the earlier date is indicated by the recent rollout of a special Convair B-36 designed to carry the first nuclear reactor aloft for shielding tests (AW Aug 8, p 9).

Shielding, of course is the major problem connected with an airborne atomic powerplant In a design study of a typical powerplant for use in a railroad locomotive, the reactor itself was shown to be a sphere of 8 m. diameter But necessary shielding would bring the diameter to approximately 14 ft Since the airplane operates in a different environment from the locomotive—it does not run through populated communities and may be based on water or remote sections of an airport—the problem is somewhat altered But the shield will still weigh around 50 tons according to Lee Ohlinger chief of the computer service and a nuclear consultant at Northrop Aircraft Inc

'Pile Paradox'

Because of the nature of what Ohlinger calls the "pile paradox," an atomic aircraft would carry a single reactor driving multiple turbines The paradox is this A certain amount of material is needed to make the reactor critical Once it reaches this point, there is no practical limit to the amount of power it will produce The only limit is how fast the energy can be taken away So one reactor is as good as two three or more as far as providing the plane with the power it needs

However, use of a single reactor with its associated shielding, imposes problems on the designer The very heavy concentration of load means that the reactor must be located at or very close to the plane's center of gravity.

One way of dealing with this problem is to split the shielding, using part of it around the reactor and part around the crew whose quarters will be a good distance away from the powerplant

Land based nuclear powered aircraft will need special runways both long and remote, because of the dangerous powerplant Ohlinger pointed out Even when the plane is not operating the reactor is radiating and deadly However, because of the plane's unlimited range, there need be only a few of these special landing areas

A proposal for a tandem plane arrangement has been advanced The atomic-powered craft would be a drone operating as a tug The drone tug would pull the second plane, containing the crew and payload The manned plane, which would have its own powerplant, could then either cut loose for landing at a conventional airport, or—if it were brought onto the remotely located runways likely to be needed for nuclear-powered plane—it could then cut its towline connection and taxi to the regular hangar area for unloading

Detachable Nose

Another proposal is for a detachable nose section housing the crew, with its own taxiing gear and powerplant After landing on the appropriate atomic runway, the crew "casts off" from the powerplant section and taxies to the hangar

Although the first nuclear powered aircraft probably will look a good deal like today's designs (but with a greatly elongated nose to get the crew as far from the reactor as possible) the landing gear will have to be much larger and stronger This is dictated by the fact that the ship will land heavy at about the same weight as it took off, having consumed practically no fuel during flight

Much work has to be done in developing materials that can resist high temperatures and corrosion for nuclear powerplants, and this is a major problem, according to Ohlinger Advances also will be needed to improve heat exchangers to meet the needs of high heat transfer rates lightness, small size and very high reliability

Because nuclear powerplants "poison" themselves over a period of time and become difficult to control when they have burned off about 10% of their fuel, Ohlinger believes it will be customary to pull out the entire reactor, but not the shielding and put in a new unit after a period of operation To handle the unshielded reactors on the ground will require "monstrous pieces of equipment," he says, another of the problems that nuclear aircraft will bring

The shielding problem will be considerably smaller in guided missiles and unmanned aircraft but will still exist because the powerplant's radiations have an ionizing effect and would completely upset the operation of exposed avionic equipment and sensitive controls.

TOMORROW'S FIGHTER Piloted and rocket-powered, the aircraft probably will resemble today's guided missile, but . . .

Instability Will Plague Mach 6 Designers

By Irving Stone

El Segundo, Calif.—Stability and control problems will plague the aircraft designer of the high-altitude planes of the near future where military aircraft may operate at heights approaching 100,000 ft. at speeds of between Mach 2 and Mach 6.

The configurations of the current fighters would not have the stability and control to operate at the upper limits of these conditions, according to Ervin R. Heald, Douglas Aircraft's El Segundo Division aerodynamic design specialist.

New design compromises will be required for this high-altitude regime of flight. One solution may be the adoption of a cruciform tail similar to that of a guided missile.

Stability and control problems will arise primarily as a result of reduced air density and the corresponding high speeds necessary to maintain lift in this low-density atmosphere.

Heald, who contends that flight handling characteristics associated with future flight have been relatively neglected in comparison with other problems such as aircraft drag and engine performance, sees static stability as one of the most difficult problems which will appear in the supersonic very high altitude era ahead.

Heald outlined stability and control problems before the recent Society of Automotive Engineers Golden Anniversary Meeting in Los Angeles. His paper considered the problems associated with aircraft capable of sustained level flight through the medium of aerodynamic lift.

Reduced Effectiveness

In an exclusive interview with AVIATION WEEK, Heald pinpointed some of the major problems involved. The principle static stability difficulty, he says, stems from reduced effectiveness of the tail surfaces at speeds approaching Mach 2. This reduced effectiveness arises from two conditions of high-altitude, high-speed flight:

- **Adverse effect of supersonic Mach number on tail lift.**
- **Blanking out,** by fuselage and wing of the vertical tail surface as a result of the high aircraft angle of attack necessary for flight at extreme altitudes.

This indicates, Heald said, that the vertical tail surface will have to be extended below the fuselage for satisfactory static stability. This configuration may introduce difficulties in takeoff and landing, but one solution during these phases may be to have the lower vertical tail hinged for movement to provide greater ground clearance.

Location of the horizontal tail in the high-speed, high-altitude flight condition at high angle of attack also will be critical, Heald said. Improper location will involve it in the wing shock wave pattern, so that the ability of the horizontal tail to stabilize the aircraft will be drastically impaired. Studies have indicated that the most trouble-free location for the horizontal tail would be on the wing-chord line for high Mach number, high-angle-of-attack flight, Heald explained.

The combination of the upper and lower vertical tails with the centrally located horizontal tail would give the aircraft empennage the appearance of a missile configuration.

Damping Decreases

Dynamic stability becomes difficult to attain at high altitudes because aerodynamic damping decreases as the true airspeed or Mach number increases, Heald said. Also, coupling between rolling, yawing and pitching motions may result in severe aircraft gyrations which are expected to become more severe at extreme altitudes. This coupling is one of the most violent forms of dynamic instability encountered to date, according to Heald.

This means, he said, that for steady flight at high altitudes the designer must pay particular attention to the overall interrelation of fuselage, wings and tail. Failure to do this will endanger stability and control characteristics.

Heald recommends these approaches to improve inherent dynamic stability:

- **Stabilizing surfaces** should be designed to compensate for the inevitable reduction in effectiveness at supersonic speeds which will be required for high-altitude flight. Generally, this compensation will be in the form of increased tail area or, more effective, by placement of the tail surfaces further from the center of gravity.
- **Unfavorable inertia distribution,** should be avoided wherever possible. One means of minimizing effects of inertia coupling, such as between roll and pitch or yaw axes, is the use of variable wing incidence. This variable feature could be used to allow the fuselage to be aligned with the airstream to minimize the coupling effects.
- **Excessive dihedral effect** should be avoided, because this also can lead to dynamic instability. This may require reduced sweepback and the placement of the vertical tail area below as well as above the fuselage to counterbalance rolling moments introduced by the upper vertical tail.

One of the principle disadvantages of wing sweep has been the excessive dihedral effect introduced by this wing configuration at high angles of attack.

In the future aircraft, wing, fuselage, tail and control surfaces would be located so that aerodynamic coupling such as pitching moment due to sideslip or yawing moment due to ailerons are minimized.

For adequate longitudinal control in a high-altitude, high-speed, high angle of attack operation, the all-movable horizontal tail will be a "must," Heald contends. Conventional elevators alone, he said will not be sufficient for the aircraft.

Conventional ailerons should be adequate, however, for lateral control and will be preferrable to spoilers to cover the range of subsonic as well as supersonic operation.

One of the current troublesome problems of high speed flight—excessive lateral control sensitivity—is not expected to become more critical with added speed and altitude increments.

Maneuvering at very high altitudes also will pose difficult interception problems.

A plane traveling at extremely high altitude and high speed is committed, essentially, to move along a straight line because of the rarefied air and high forward speed, Heald said.

Maneuvering in a circle under this condition of flight becomes difficult because of the extremely high centrifugal force, which cannot be counterbalanced by the available wing lift in bank.

Thus, minimum flying distances for a 180 deg. turn increases from about 64 miles at 50,000 ft. to about 74 miles at 100,000 ft.

Army Molds Air Weapon Arsenal

Fort Benning, Ga.—The U. S. Army is not satisfied with the Key West agreement limiting the size, weight and area of activity for Army aviation.

Gen. Maxwell D. Taylor, Chief of Staff, told reporters at the first annual meeting of the Association of the United States Army "no written agreement could be satisfactory." His comment followed closely on disclosure that the ground forces are working on development of long range and anti-aircraft missiles with atomic warheads.

General Taylor spoke out at a two-day session of a new organization clearly set up to parallel efforts of the Air Force Association by promoting the Army as "the only self-contained force that can defeat an enemy, move into the enemy's vital areas—and stay there."

In a practical challenge of the air power doctrine that the long range strategic bomber is the major deterrent to foreign agression, General Taylor argued that soldiers overseas as well as standing and reserve forces at home help prevent another war.

Confident of Future

He saw no basis for Army discouragement in an age of atomic and nuclear warfare. He said he was told on assuming his present position that the Army was 'in the doghouse,' that it was consistently in a minority position in the important positions taken by the Joint Chiefs of Staff and that it was a forgotten service.

General Taylor said he cannot share that feeling. At the association meeting he was bullwarked in this view by these other top Army officials:

- **Wilber M. Brucker, Secretary of the Army,** said "nothing has occurred on the world scene that diminishes the fundamental role of land forces. . . . Land forces are a prime element in any nation's security structure. . . . The Army will provide the ultimate force by which victory is achieved."
- **Lt. Gen. James M. Gavin, Chief of Research and Development,** stressed that the Army is taking advantage of "the military innovations introduced by modern technology" and "is the principal instrument of military power that has the capability of deterring war and—if the deterrence should fail—of winning a worthwhile peace."

'Unbelievable Missile'

It was General Gavin who supplied the Association of the U. S. Army with a bill of particulars on how this will be achieved.

He disclosed that the Army is working on missiles of "almost unbelievable possibilities both for anti-aircraft and anti-tank purposes and for all kinds of other enemy targets."

The potentialities of such missiles, he said, "Stagger the imagination" if they are equipped with nuclear warheads.

In a preview of other military developments for the decade of 1960 to 1970, Gen. Gavin predicted:

- **An interceptor missile** to knock down the still undeveloped intercontinental ballistics missile.
- **An improved Redstone** tactical missile with long range to hit targets behind enemy lines.
- **For the battlefield,** a bigger version of the Corporal, to be called the Sergeant, that will use a solid propellant.
- **Small rockets** like the Honest John, comparable to long range artillery, but equipped with greater power.
- **Smaller and more mobile** atomic cannon than the present 280 mm. gun.

Pilots Expendable

Gen. Gavin also spoke glowingly of improvements in the Nike anti-aircraft missile and said future versions will be able to destroy any airplane at any speed or altitude. He suggested that the day of the piloted airplane is numbered, indicating that the Army will be able to provide complete defense against its replacements.

The Army's research chief predicted big increases in air mobility.

"To fight successfully on the battlefield visualized for the future," he said, "Our Army must be mobile not only on the ground but in the air. . . . The majority of supplies for the battle area should be delivered by aircraft of the assault cargo and convertiplane type, and tactical transport of units into and within the battle area must be accomplished by basic reliance placed upon aircraft and fast moving naval vessels."

Demonstrations of equipment, techniques and training at this famous Infantry School reflect the Army's complete concern with air logistics. From the paratrooper school and equipment for training soldiers to load and unload transport planes to the helicopter and light plane units, full emphasis is placed on air operations.

During the meeting there was almost no mention of the sister services of the Navy and Air Force.

Emphasis was on the teamwork necessary in the Army to keep that branch of the Defense Department in its traditional role.

Gen. Lyman L. Lemnitzer, president of the association now on duty in Japan and Korea, said in a message that "the very survival of the Army . . . is at stake and depends in large measure on our ability to close ranks promptly and effectively for the good of the Army and the nation as a whole."

Republic Sales and Profits Double; Northrop Turns in Banner Year

Underscoring American prosperity and efforts at preparedness, a number of U S aircraft manufacturers last week were telling their stockholders of increased sales, more profits and optimistic plans for the future Among them

• **Republic Aviation Corp.** reported net earnings for the first three quarters of 1955 at $12,312,873 (after provision for U S and foreign taxes) on sales of $422,607,390 The earnings, approximately double those registered over the same period last year, represent $9 20 a share on 1,338,194 shares of common stock outstanding and compare with $6,192,292 net on sales of $225,961,164 during the equivalent period of 1954

At the same time, the company announced plans for a $12 million expansion program, including the construction of a new wind tunnel capable of running tests at speeds of up to Mach 4

• **Northrop Aircraft, Inc** reported consolidated sales and other income for the fiscal year ending July 31 (the best in its history) at $283,462,522, as compared with $171,666,343 for the preceding fiscal year Consolidated net income for the period amounted to $11,738,764 after federal taxes ($7 89 per share on 1,488,628 shares of common stock) as compared with $3,829,387 ($2 62 a share after a stock split) for Fiscal 1954.

Northrop President Whitley C Collins said in his annual report to stockholders that "sales and earnings for the fiscal year . . . were the highest for any one year since the inception of the company in 1939."

• **Glenn L Martin Co.** reported its net income for the nine months ending Sept 30 at $9,193,909 and sales at $194 805,592 as compared with $187-178,497 in sales over the same period of 1954 On the books, the 1954 report of net income was somewhat higher $14,506,087), but Martin officials attribute this to the fact that provisions for federal income taxes were made in the current report but not in last year's Net income per share for the nine month period was equivalent to $3 58 on 2 570,416 shares outstanding

• **Beech Aircraft Corp** announced that total sales for the fiscal year ending Sept 30 "were in excess of $76 million." Mrs O A Beech, company president, told stockholders that net earnings on 749,289 outstanding shares of common stock should amount to more than $4 75 per share after taxes The backlog of Beechcraft orders was estimated at $63 million.

Commercial plane sales for the year, the company reported, totaled $27,400,000 as compared with $19,600,000 during the 1954 period Broken down, the company reported that unit sales of the Beechcraft Super 18 showed a 84% gain the Twin Bonanza, 21 6%, and the Beechcraft Bonanza, 20 5%

• **Cessna Aircraft Corp** estimated sales for the year ending Sept 30 at $50,000,000 with commercial aircraft sales jumping some 80% ($21,650,000 from $12,135,749) to account for 43% of the company's business Cessna President Dwane L Wallace said net earnings should exceed $3 75 per share as compared with $2 97 for last year

Republic's Expansion Plans

In his report, Republic President Mundy I Peale said the backlog of unfilled orders for F-84F Thunderstreak fighter-bombers and RF 84F photo reconnaissance planes plus spare parts amounted to about $600 million

Of the $12 million set aside for expansion, $6 million will be expended by the end of the year The remainder is scheduled to be spent in 1956

The largest item on the program is the proposed wind tunnel to be housed within the recently-purchased building and grounds of the Fairchild Engine & Airplane Co engine division adjacent to Republic's main plant at Farmingdale, L I, N Y. The tunnel will require new high power electric generating equipment

(The former Fairchild property as a whole will be used to expand engineering and experimental work

In his announcement of the expansion, Peale said

"By expending a sum which is equivalent to more than 40% of anticipated net earnings for 1955 . . . Republic intends to maintain and improve its prominent position as a designer and manufacturer of very advanced jet aircraft for the U S government"

The program will include new machinery to work with such metals as titanium, magnesium and a number of new heat resisting alloys and high-temperature structural and functional apparatus that can duplicate flight conditions at 50,000 ft and above

Plans also call for facilities for testing aircraft engines developing as much as 25,000 lb thrust and for a parallel noise reduction program

Republic, Peale said, will complete production of the Thunderstreak at about the same time and will continue production of the RF-84F Thunderstreak "until late spring"

Northrop Report

President Collins attributed Northrop's rise in sales and profits to four major causes

• **Production efforts on fixed-price contracts** during the 1953 54 year were not reflected in sales and earnings until the final quarter of the year

• **Aircraft deliveries during the year just past** were made continuously and in substantial volume

• **Increased efficiency** earned the company incentive profits as well as regular contract profits

• **Lower federal income-tax rates**

The Scorpion F 89 interceptor accounted for the major portion of Northrop's sales and earnings during the fiscal year

Other contributing activities included the development of guided missiles, production of target planes, optical, mechanical and electronic components, and design work on advanced aircraft

Northrop's consolidated sales backlog as of July 31 was approximately $281,000 000—consisting principally of Scorpion F-89s, guided missiles and target drones—as compared with a $512,000,000 backlog on July 31, 1954.

Collins said present plans call for continued deliveries of Scorpions at the same rate as in 1955, possibly until production requirements for the F-89 are completed in August, 1956 He added, however, that "sales and earnings on these deliveries will be less than those for 1955 because the sales and price and profit have been reduced"

The annual report said that Northrop also is considering the issuance of $10 million in convertible subordinated debentures Proceeds form the sale, Collins said, would be used to augment working capital and to strengthen the company's competitive position and capabilities in both research and manufacture.

New Volscan System

Flight tests of a new improved model of the Volscan automatic traffic-control system are scheduled to begin sometime in December at Clinton County Air Force Base, Ohio. The new AN/GSN 3, an engineering model built by Crosley Division of Avco Manufacturing Co, is designed to handle 14 aircraft simultaneously as compared with the six-aircraft capability of the original unit developed by the USAF Cambridge Research Center (AW Dec 28, 1953, p 38)

The system, operating from data obtained from a surveillance radar, automatically determines the earliest possible non-conflicting time of arrival at an airport for each aircraft then computes the flight path each plane must fly to bring it in at the proper time During the forthcoming tests, attempts will be made to improve the rate at which aircraft can be scheduled for landing

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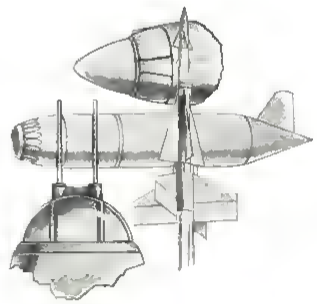
Just as early Americans depended on the sturdy heart and the steady hands of pione- 'ike Daniel Boone to lead them safely to new frontiers, so today do Americans depend on present day pioneers in science and industry to lead them safely to new frontiers of security, through progress.

At Rheem we are proud to play a part in this progress and proud, too, of the record of dependability we have established in research, engineering and production. Low per-unit cost and on-time completion schedules are routine at Rheem

Rheem's integrated Government Products facilities are presently in quality development and production on air frames, missile and jet-engine components, airborne ordnance, electronics and ordnance materiel



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Six vital steps to help strengthen national defense

Here are six important steps Burroughs is performing all of them They are vital in making our national defenses stronger.

These steps are the complete cycle of defense work. With the extensive and complete facilities at our command, and by working in close cooperation with the Armed Forces, Burroughs is making many important defense contributions. These are in the fields of instrumentation, control systems, communications, magnetic and electronic components and electronic computers. Address inquiries to Burroughs Corporation, Detroit 32, Michigan.

2. DEVELOPMENT

Burroughs

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Burroughs Electronic Instruments Division, Philadelphia, Pa.
Heydu Brothers of New Jersey, Plainfield, New Jersey
Control Instrument Company, Brooklyn, New York
Burroughs Research Center, Pasadena

By 1965:

Electronics Output Will Double

The electronics industry will more than double in the next decade from an annual dollar volume of $9 5 billion to $20 billion, Don G Mitchell chairman and president of Sylvania Electric Products, told the Joint Congressional Economic Committee studying the effects of automation and technological advances.

Since 1940, the industry has mushroomed from an employe force of 70,000 and a $500 million annual volume of business to employment of 700,000 and the $9 5 billion business volume

Mitchell, and other industry spokesmen, were apprehensive over a future labor shortage, while labor representatives called for a series of new employe benefits to cushion the effects of dislocations and unemployment resulting from automation of industry.

"I not only do not even remotely fear that mechanization, or automation will cause unemployment but I am concerned about the strong probability of a labor shortage in the years ahead unless the rate of mechanization is increased," Mitchell declared. Pointing out that industrial employment increased from 44 million to 50 million between 1947 to 1954 he observed that "if production techniques had not progressed 58 million persons would have been required to produce the goods and services actually demanded in 1954."

Robert C Tait, president of Stromberg-Carlson Co and Senior Vice President of General Dynamics Corp., said he believed automation "may be a lifesaver at this particular time in our history when we are facing a more rapid relative increase in total population over the next decade than in the work force, because the big increase in population during the next decade is taking place in the young and over 65 ages and not so much in the work force ages."

In the aircraft industry, Tait said the installation of expensive automation machinery in production probably would be economical because of high unit cost of some aircraft parts. Even though only 100 aircraft might be produced he suggested this might represent a $500 million volume of business

Walter P. Reuther, president of the Congress of Industrial Organizations, estimated that automation would reduce the work week over the next decade to 30 or 35 hours probably 32. Tait estimated it would be cut to approximately 35 hours.

Reuther called for government—and industry—sponsored retraining programs and re-location allowances for workers whose positions are replaced by machines. reduction in the 65-year age for social security benefits, increased wages and reduced prices to build-up purchasing power and guaranteed annual wage plans for workers

To curb "irresponsible action," Reuther said employers should be required "to pay some of the social costs of policies which result in unemployment Consideration should be given as to whether the costs of helping workers adjust to the changes produced by automation should be borne by society as a whole, or whether some means should be sought for employers to bear a share of the burden."

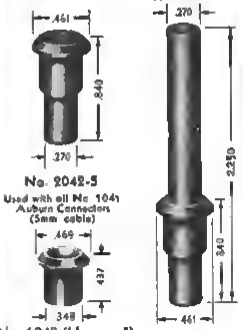
He maintained that "it is just as reasonable to expect the employer to pay

Fairchild's Midget Sub

Midget submarine, shown on shakedown cruise in Long Island Sound with a company crew aboard, was designed and built by Fairchild Engine Division for the U. S Navy. This sub is intended to test harbor defenses but could also be the forerunner of midget submarines for use in close-in attacks on harbor installations, shipping and underwater obstacles. Control system of sub resembles that of an airplane's with control from a single point using a single column and wheel. One man can handle the midget. Full complement is a commander and four crewmen. A. T Gregory, chief engineer, and Theodore Hammen, assistant chief engineer were responsible for design and production of the unique craft. William Rand, project engineer and ex-submariner, was acting commander during the shakedown cruise.

Auburn
IGNITION ACCESSORIES

Terminal Collars (Seals)
Ozone Resistant Hypreen



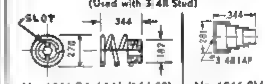
No. 2042-S
Used with all No. 1041 Auburn Connectors (5mm cable)

No. 1042 (Hypreen®)
No. 1043 (Silicone)
Used with all No. 1041 Auburn Connectors (7mm cable)

No. 1042-S
Used with all No. 1041 Auburn Connectors (5mm cable)

Auburn Synthetic Rubber

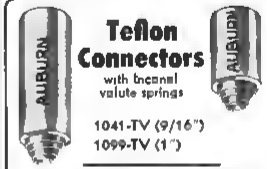
SPRING AND EYELET ASSEMBLIES
(Used with 3-48 Stud)



No. 1066-SA (AN 4164-22) with stainless steel coil springs

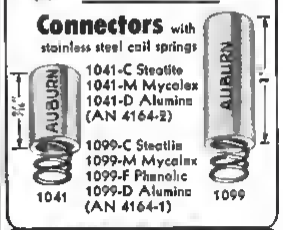
No. 1066-SV with Inconel volute springs

Teflon Connectors
with Inconel volute springs



1041-TV (9/16")
1099-TV (1")

Connectors with stainless steel coil springs



1041-C Steatite
1041-M Mycalex
1041-D Alumina (AN 4164-2)

1099-C Steatite
1099-M Mycalex
1099-F Phenolic
1099-D Alumina (AN 4164-1)

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America's most complete line of arc welding equipment and electrodes

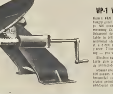
UP-1000 Welding Positioner

A light touch of the hand is all it takes to position weldments up to 1000 pounds positively and quickly with the P&H UP 1000. The welder simply clamps the work piece to the table and adjusts tilting tension with the clamp. An exclusive feature then keeps the unit in static balance regardless of whether the piece is rotated through a full 360° or moved horizontally or vertically.

With a light push the welder guides the piece to the desired angle he wants as the work progresses for economical downhand welding all the way through.

The P&H UP 1000 occupies a floor space of just 22" x 26" and weighs only 200 pounds.

only $395



only $295

WP-1 Welding Positioner

Here's P&H quality in a low-priced work-hungry positioner that handles weldments up to 500 pounds. Ideal for floor or bench mounting. Gives you full 360° table rotation. Advanced design permits the 24" diameter table to tilt 135° from horizontal without weldment striking the floor — makes it a cinch to reach out nearly troublesome places. Tilting crank has spring lock indexing — you set it and it stays.

Electrically controlled motor driven turntable also available — to provide stepped up production.

Manual and easily portable — weighs only 100 pounds. Stands 15½" high with table in horizontal position. Optional equipment includes pedestal for floor mounting at slight additional charge.

P&H Announces the UP-1000 and WP-1

Two new P&H Welding Positioners so reasonably priced that no plant can afford to be without them

Now with these two new P&H units, economical downhand welding is within the range of every small plant or department. And for the first time, low-cost, positioned work is practical, even on the smallest weldments.

With these two units, you consistently turn out better, faster, lower cost work because you weld straight through in the downhand position. You end wasted motion, constant repositioning of the piece. You use larger, better electrodes to deposit metal up to twice as fast. And you make stronger better-looking welds too — welds that help add sales appeal to your product.

Whatever you weld you're ahead with one or both of these low priced P&H cost-cutters. Put them to work for you and watch productivity increase, costs drop. Order now from your nearby P&H distributor or write P&H Welding Division, Harnischfeger Corporation, 4695 W National Avenue, Milwaukee 46, Wisconsin.

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the cost of retraining, including the payment of wages during the retraining period, as it is that he should pay the cost of building the new plant or installing the new equipment. When a plant is moved to a new locality ... the employer has a responsibility not merely to retain workers who wish to move with the plant, but also to bear at least part of their cost of moving and new housing. There are just as much costs arising out of the employer's business decision, as the business costs he now takes for granted."

Four Airlines Receive Rapid Tax Write-Offs

Four airlines have been awarded rapid tax amortization benefits for 80% of their new plane purchases by the Office of Defense Mobilization.

The airlines and the amount certified for tax benefits are: National Airlines, $2.4 million, Northwest Airlines, $4.7 million, American Airlines, $7.9 million, and Braniff Airways, $19.3 million.

Other aviation firms awarded certificates for rapid write-off tax benefits for the period from Sept. 22 through Oct. 5 were:

Curtiss-Wright Corp., Wright Aeronautical Div., Wood-Ridge, N. J., military aircraft engines, $324,613 certified with 65% allowed.

General Precision Laboratory Inc., Pleasantville, N. Y., research and development of electronic products, $22,111 certified with 70% allowed.

Farrand Optical Company Inc., New York, N. Y., military scientific instruments, $37,461 certified with 65% allowed.

Globe Industries Inc., Dayton, Ohio, electric motors for military aircraft, $150,000 certified with 45% allowed.

Motorola, Inc., Phoenix, Ariz., research and development of electronic products, $42,898 certified with 6% allowed.

The Ryan Aeronautical Co., San Diego, Calif., aircraft components, $68,528 certified with 45% allowed.

American Machine & Foundry Co., Electronics Div., Boston, Mass., military electronic equipment, $18,792 certified with 65% allowed.

Premier Instrument Corp., New York, N. Y., electronic components, $10,680 certified with 70% allowed.

Bogart Manufacturing Corp., Brooklyn, N. Y., electronic components, $14,384 certified with 70% allowed.

Gosson Corporation, Newark, N. J., aircraft components, $60,853 certified with 85% allowed.

Sligo Precision Products Inc., Cicero, Ill., military aircraft parts, $23,423 certified with 70% allowed.

Western Electric Co., Inc., Greensboro, N. C., military aircraft parts, $34,180 certified with 65% allowed.

Sundstrand Machine Tool Co., Rockford, Ill., military aircraft components, $261,000 certified with 45% allowed.

United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn., military aircraft components, $197,123 certified with 65% allowed.

McDonnell Aircraft Corp., St. Louis, Mo., bomb shelter, $98,000 certified with 100% allowed.

Bendix Aviation Corp., Mishawaka, Ind., ordnance, $7,961 certified with 85% allowed.

Hydro Electric, Burbank, Calif., military aircraft parts, $48,474 certified with 45% allowed.

Fairchild Engine and Airplane Corp., Guided Missiles Div., Wyandanch, N. Y., military aircraft, $6,617 certified with 85% allowed.

taping the data of

Aviation-Electronics

Davies magnetic tape equipment and systems for recording, reproducing, and analyzing data

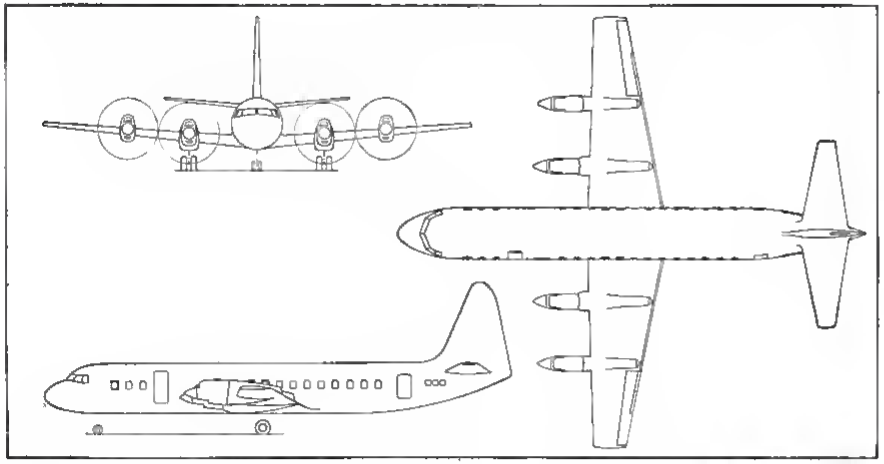
STANDARD RECORDING & PLAYBACK HEADS
Precision multi-track heads, shielded for negligible cross talk. Precision gap alignment for uniform time and phase reproduction among the various tracks. Encapsulated in thermosetting resin. Complete range available from 2 tracks on ¼" tape, to 42 tracks on 2" tape—for use in data processing equipment, analog and digital work, telemetering and automatic control.
WRITE FOR BULLETIN 55-B

RECORDERS—PORTABLE & LABORATORY
Portable recorders, flight-proved to withstand extreme conditions, furnished as self-contained units or subdivided for space/weight distribution. Laboratory recorders are available with complete reproducing systems as an integral unit. Both have a full range of speeds for direct recording or recording by FM, PWM, or digital pulse—with full wow and flutter compensation.
WRITE FOR BULLETINS 54-D AND 54-E

REPRODUCERS
These unitized assemblies reproduce data from all Davies recorders with unparalleled accuracy. They include a tape transport mechanism, a speed control servo, and playback amplifiers with power supply, for direct recorded, PWM, or digital signals and a high stability discriminator, in addition, for FM carrier systems. Units are available individually or as a complete system.
WRITE FOR BULLETIN 54-D

AUTOMATIC WAVE ANALYZER
This heterodyne type analyzer provides a complete fourier analysis (amplitude vs. frequency) of up to 14 inputs—all automatically. It is adaptable to any source supplying a repetitive signal in the range of 3 to 2000 cps to analyze signals from vibration, transients, noise, shock, power lines, etc.
WRITE FOR BULLETIN 54-C

THE Davies LABORATORIES INC.
4705 Queensbury Road • Riverdale, Maryland



ELECTRA THREE-VIEW shows long tubular fuselage large clearance between propeller tips and fuselage low off ground height

Electra Design Finalized, Sent to Shops

By David A. Anderton

Finalized drawings of the Lockheed Electra have been released to tooling, production shop and subcontractors, signalling the start of intense effort to meet the programmed first-flight date of Nov 1, 1957

Approximately one year later (in late 1958), Lockheed expects to start deliveries of the new turboprop transport to American Airlines and Eastern Air Lines, who bought a total of 75 Electras

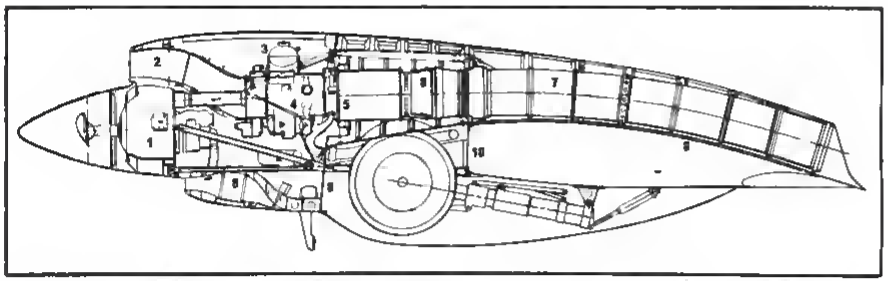
The finished configuration shows minor differences in appearance from the original design that won the design competition touched off by C R Smith, American Airlines president Biggest change—a 1,300 sq ft wing up 100 sq ft from the earlier layout—was forced by a study of Eastern's routes Eighteen of the airline's 88 fields would have been barred to the original Electra because of runway length limitations with the increased wing area, the plane can make the entire EAL system

Electra Economies

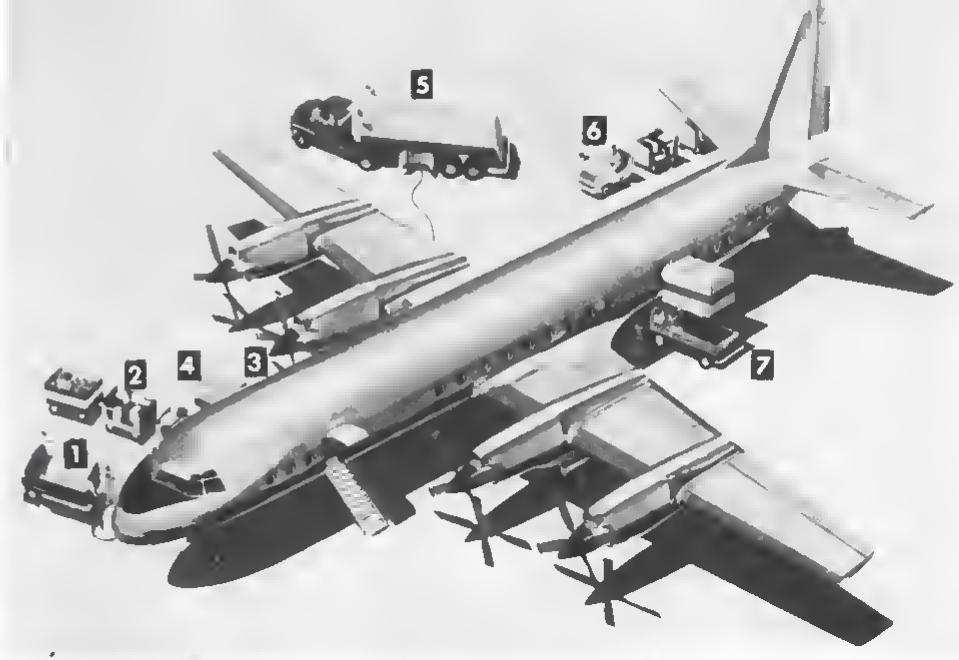
Cruise and block speeds are down about 2 or 3% as a result of the change, but payload-range performance, as well as takeoff, climb out and landing have been improved markedly

Lockheed's persuasive sales arguments concentrate on an economical airplane with operational flexibility for short or medium-range use The four Allison 501 turboprops will take a 20,600-lb payload a distance of 2,500 statute miles The airplane will be fast on turnaround and easy to maintain Its structure will be designed around fail-safe principles

Passengers will ride in quiet, pressurized cabins The custom version will carry 66 (85 seats plus six available in the lounge will be installed on the high-density version) Seats will be wider than those commonly available today, a Lockheed concession to the sedentary businessman who makes up such a large segment of airline revenue Even in the coach setup, says the company, the center seat in the group of three will be the same width as those currently standard in the Convair



ALLISON 501 NACELLE (1) gear box, (2) air intake, (3) oil tank, (4) compressor, (5) fire seal, (6) turbine, (7) tailpipe (8) oil cooler, (9) firewall, (10) front spar.



ELECTRA SERVICING (1) electrical ground power unit; (2) cargo cart, (3) water replenishing, (4) toilet servicing, (5) fuel truck, (6) tractor, (7) galley servicing

Interior Layout

Cabin section of the cylindrical fuselage is a constant 128 in inside diameter from the first row of seats to the next-to-the last row The passenger-loading door is forward with carry on luggage storage adjacent and lavatories opposite. A rear door allows servicing of the galley (it may possibly become a second passenger entrance if there is enough customer demand)

Forward of the entrance are 14 seats in the custom version, 17 in the coach The main cabin contains the remainder of the seats and a galley, the rear section is a lounge seating six

Conversion from custom to coach is simply a matter of replacing chairs the seat pitch of 38 inches remains constant for both plans Custom seats are 20 in wide between armrests have an individual foldaway table and a footrest Aisle width is 22 in Coach seats are 17½ in between armrests—except for the center of the three-group, which is 18 in—and installed, leave an aisle of 17-in width

Windows are rectangular, and measure 16 by 18 in the larger dimension is vertical and the window sills have been lowered to improve the view downward

Cabin pressure can be maintained at sea level up to an outside altitude of 15,000 ft maximum pressure altitude is 8,000 ft in the cabin at an outside height of 30,000 ft

Propeller tips clear the fuselage by three feet to reduce drumming on the skin soundproofing further quiets the engine and prop noise The exhaust should be quiet because by the time the turbines have extracted power to turn the props and compressors, there is little energy left to make noise

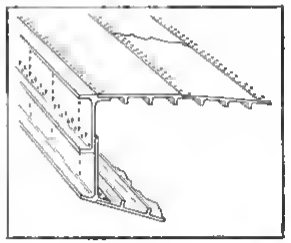
Flight Deck

Cockpit layout follows the standards established by the Society of Automotive Engineers committee Normal crew is three with the flight engineer seated between and slightly behind the pilot and co-pilot There is a seat for an observer or check pilot behind the pilot

Flight kits can be stowed outboard of the crew seats, and storage for their coats hats and luggage is also provided There is full cabin headroom over the aisle on the flight deck

Autopilot and weather avoidance radar are to be standard on the Electra Thermal deicing of all leading edges and the air scoops are designed to handle "NACA heavy", ice NESA windshields are standard

Control grouping on the pedestal is planned for efficiency to avoid possible



FAIL-SAFE STRUCTURE for wing tension side.

Salute to the Paris

Early in June 1955 the twin-jet, four-place executive airplane PARIS, built by Morane-Saulnier of France with the type designation MS 760, started a demonstration tour of the United States and Canada under the sponsorship of the Beech Aircraft Corporation.

In ninety days it carried a total of 1820 people, not including the pilots. It made 724 demonstration flights from a total of 38 different airports.

It never required a revision of schedule or cancellation of a flight, in spite of an itinerary that was planned sixty days in advance.

Its record of maintenance shows that less than 0.85 man-hours of maintenance time was required per hour of flight time for this 410 miles-per-hour airplane.

It never required a battery cart for starting the two jet engines, or even an overnight battery charge.

The reaction of skilled jet pilots to both its flight and landing characteristics has been uniformly one of enthusiasm and pleasure. One top-level jet expert expressed it briefly, "Goshalmighty, *what* a Doll!"

BEECHCRAFT salutes the Morane Saulnier designers and constructors for an outstanding achievement and a milestone in aeronautical progress – the MS 760 "PARIS"

This is the route of the "Paris" on Beechcraft's ninety-day nation-wide demonstration tour.

Beech Aircraft Corporation
Wichita, Kansas, U. S. A.

BEECHCRAFTS ARE THE AIR FLEET OF AMERICAN BUSINESS

New Electra Specs

DIMENSIONS AND AREAS

Wing Area	1,400 sq. ft.
Wing Span	99 ft.
Fuselage Length	104 ft. 2 in.
Fuselage Inside Diameter	128 inches
Height Over Tail	32 ft. 3 in.

STRUCTURAL DATA

Takeoff Structural Design Gross Weight	110,000 lbs.
Landing Structural Design Gross Weight	93,370 lbs.
Maximum Gross Weight with 15 Minutes Fuel	80,555 lbs.
Limit Maneuver Load Factors	Positive 2.50, Negative 1.00
Maximum Limit Gust Load Criteria	50 f.p.s. up to 324 kts. EAS (600 km hr.)
Design Limit Diving Speed	405 kts EAS below 8,000 ft.
Design Limit Level Flight Speed	324 kts EAS below 12,000 ft. and Mach. .615 above 12,000 ft.

WEIGHTS

Weight Empty		54,000 lbs.
Operating Equipment (Total)		2,817 lbs.
Crew and Crew Baggage	847 lbs.	
Passenger & Service Equip.	1,461 lbs.	
Unusable Fuel and Oil	324 lbs.	
Usable Oil	195 lbs.	
Operating Weight		56,817 lbs.
Payload (Weight Limit)		20,600 lbs.
Passengers (91)	15,015 lbs.	
Baggage	3,640 lbs.	
Cargo	1,945 lbs.	
Fuel Reserve		7,030 lbs.
Trip Fuel		23,280 lbs.
Design Gross Takeoff Weight		110,000 lbs.
Design Landing Weight		93,370 lbs.

confusion. For example, flap and landing gear controls, even though shaped differently, also are separated as far as they can be in the layout of the pedestal. The floor behind the pedestal is used to step on, not to house additional controls.

The landing gear is designed to free-fall and lock over a wide range of flight attitudes. Retraction, which can not be done on the ground unless hydraulic power is applied, takes ten seconds. Landing gear is stressed to be used in flight for speed brakes.

Propellers are four-bladed, reversible pitch with automatic feathering for takeoff. Power failure of the engine triggers a pitch increase in the prop mechanism even without this there is enough vertical tail—and power to move it—to handle the unsymmetrical conditions of full prop drag on one engine and power on the others.

All flight controls are powered, complete dual system is used.

Structure

At the root of the Electra detail design is the principle of "fail-safe" structural design, fostered and encouraged in a personal crusade by a few men in industry. Most of the credit for leading the crusade goes to Richard V. Rhode of NACA's executive staff.

Basically, "fail-safe" structure means what the term says, it is an arrangement designed so that if one member fails, the rest of the component still carries the load.

Lockheed structural designers came up with an unusual fuselage "fail-safe" scheme. The basic structure is the conventional layout of skin, stringer and rings with the rings attached directly to the skin. Also attached to the skin is a sheet metal grid which effectively increases the area and reduces the stress wherever the skin is riveted or fastened. This grid accomplishes two things: it minimizes the chance of fatigue cracks by reducing the local stresses, and it serves as a series of crack stoppers if the fuselage should be punctured.

Unique problems of the passenger door in the pressurized fuselage led to a unique solution. Lockheed wanted to get the appeal of an integral door that opened outward and over the entrance, but it is difficult to seal such a layout in a pressurized fuselage. Lockheed's solution was to provide a pressure-tight door inside the main entrance door. The pressure door is located between two structural bulkheads on either side of the main passenger entrance and takes all the pressurization loads. The outside door takes only the local aerodynamic and inertia loads.

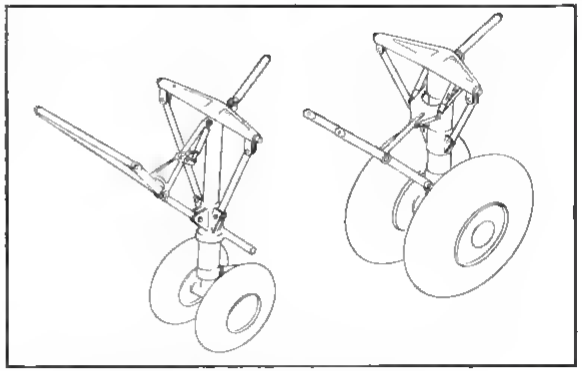
Window frames are laid out with large fillets, these, and the generally low level of operating stresses, round out lift of "fail-safe" principles in fuselage.

In the wing, the box beam is of machined and extruded shapes. Upper and lower surfaces are integrally stiffened; front and rear spars are machined webs with external riveted stringers. Truss ribs support the structure.

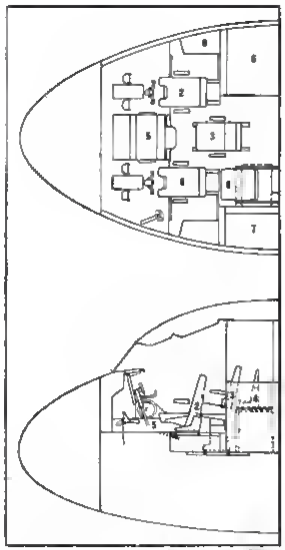
Each skin surface of the box beam is separated by a lap joint into panels of about 20 in. chord. If a crack originates in one panel, and propagates completely across it to the joint—which serves as a crack-stopper—there is strength enough left in beam to assume load.

Powerplants

The Allison 501 turboprops are the commercial versions of the T56 now going into the Lockheed C-130. By the time the Electra gets into service



TRICYCLE GEAR is conventional, simple, rugged. Actuation is hydraulic; retraction of main wheel is into inboard nacelles.



FLIGHT DECK LAYOUT: (1) pilot position, (2) co pilot, (3) flight engineer, (4) observer, (5) control pedestal, (6) electrical equipment; (7) radio and avionics, (8) flight kit storage

Allison expects to show about a half million hours of flight time on the T56, an invaluable preliminary to commercial operations.

With 3,750 hp available per engine at present, Allison and Lockheed are looking to advanced engine developments to keep the Electra fresh. Structurally, the plane can take up to 4,500 hp per nacelle. Aerodynamically, the layout will operate efficiently with engines up to about 5,500 hp.

Each 501 turboprop is housed in a nacelle which has been laid out by the area rule (AW Sept. 12, p. 12) to minimize interference drag rise. A power egg completes the nacelle forward of the firewall (it can be pulled off by making the usual disconnects of fittings and removing four mount bolts). Air inlet is over the spinner to avoid foreign object damage during ground running, takeoff or landing.

Hinged panels forward of the firewall open upward for engine access during line maintenance. Panels can be removed at hinges if necessary.

Final selection of the propeller has yet to be made, the choice is between a Curtiss-Wright turboelectric and an Aeroproducts unit.

The exhaust of the 501 is dumped just downstream of the trailing edge, a change from the earlier layouts which exhausted a few inches upstream, in order to avoid blasting the hot air on the flaps.

Fuel load of 5,250 gallons is carried in four integral cells, fueled from a single point center at the lower aft end of number three nacelle. Standard overwing refueling facilities are provided for airport use where the single-point system is not available.

Maintenance

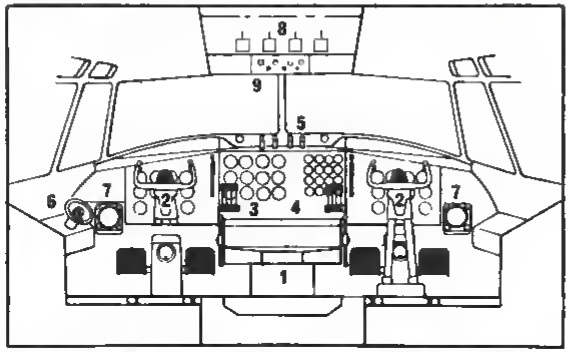
Most of the airplane services—air conditioning, electrical, pneumatic and hydraulic systems—are "centralized" in bays under the floor. All equipment in these compartments is reached through inward-opening doors. The inside of the bay is lighted and painted white for high reflectivity. Airline experience has been the guide for design of these maintenance centers.

Lockheed says that servicing of the Electra will take 12 minutes at enroute stops; complete turnarounds will take 20 minutes. Spacing of the servicing points accounts for these short times.

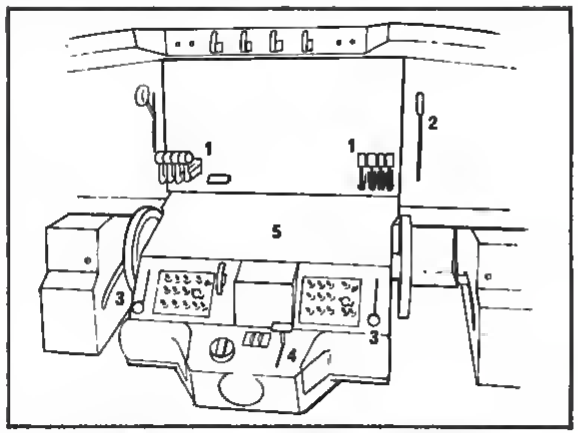
Performance

Finalized performance figures for the Electra, based on the new wing of 1,300 sq. ft. area, haven't completely shaken down. Brochure figures dated Oct. 1 were superseded by the wing area change which was made just a few hours before the start of the recent International Air Transport Association meeting in New York (AW Oct. 24, p. 108).

Lockheed gives the cruising speed of



COCKPIT LAYOUT: (1) control pedestal; (2) control column, (3) autopilot, (4) engine instruments, (5) fire extinguishing; (6) ground steering, (7) weather radar scopes, (8) condition levers (9) fuel control panel



PEDESTAL DETAIL: (1) power controls, (2) landing gear, (3) flight idle gate release; (4) flap controls, (5) radio controls.

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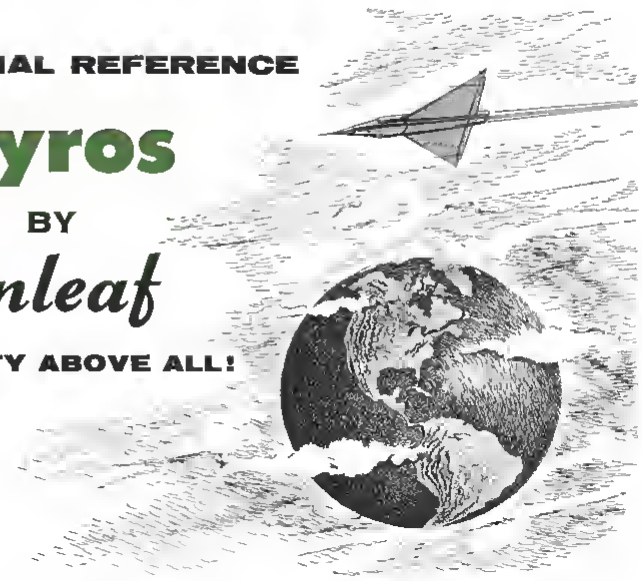

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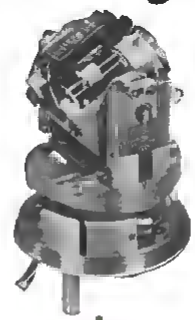

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   - *a. 115 VAC 400 CPS 1 and 3 Phase
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   - c. Warm-up Time 1 Minute at 75° F.
   - d. Temperature—From -65°F. to +180°F.

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   - b. Drift Rate—1.0° per Minute Maximum
   - c. Gyro Freedom—Inner Gimble ±70°. Outer Gimble 360°.

3. PICK OFF DATA
   - *a. Type—Potentiometer
   - *b. Linearity—0.3%
   - *c. Resolution—.25°
   - *d. Resistance—5000 ohms
   - e. Excitation—5 Volts D.C.
   - f. Dead Space—2° Maximum

4. CAGING MECHANISM
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   - *b. Mechanical Caging

*Can be modified to conform to customer's requirements

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the Electra as 410 mph and says the plane can take a full payload and fuel for a 1,850-mi flight against a 50 mph headwind off an airport runway only 4,850 ft long.

With the old wing, the Electra could climb to 25,000 ft in 24½ min; the 1,300-sq. ft. surface should reduce that time by a noticeable margin.

Lockheed is aiming at a production rate of 11 Electras per month when the line begins rolling in the Burbank plant. Right now, the first space layouts of the factory are being made and tooling is scheduled to start before the end of the year. First parts for the new plane are scheduled for early spring.

Meanwhile, Lockheed has worked out a unique subcontract scheme with four aircraft firms to detail and build Electra components. Instead of being handed drawings complete to the last rivet and being forced to produce components to an unfamiliar design, Lockheed subcontractors will get master layouts. From these, they will detail their own operational practice into the final fabrication of the units.

Menasco Manufacturing Co. will turn out landing gears. Northrop Aircraft, Inc., will produce the tail. Rohr Aircraft Corp. will fabricate the complete powerplant package. Temco Aircraft Corp. will produce wing flaps and ailerons.

Thus far, Lockheed reports the Electra project is progressing "on schedule." The firm looks to continued production of the new transport through a life as long or longer than that of the Constellation series, which is now in its second decade.

Transparent Coating To Prevent Fogging

Sierracote, a new electrically conductive transparent coating, is designed to prevent fogging on the inner surface of aircraft windows made of glass and polyester plastics such as Sierracin 611. At the same time, it reflects up to 75% of solar infrared rays.

Presently being evaluated on several military aircraft, including the Convair F-102A and the Douglas RB-66, the electrically heated Sierracote system is said to be much lighter than the systems that are currently used in hot air installations.

Sierracin Corp., which manufactures the product, says this is the first time heatable coatings for aircraft windshields and canopies have been adapted to compound curved areas or various plastics.

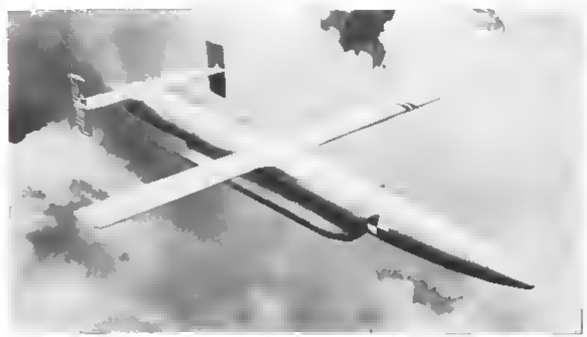
Visible light transmission of polyester sheets coated with Sierracote is about 60-70%.

This figure compares with 90% for uncoated polyester.

The material does not work satisfactorily with acrylic plastics at present, says Sierracin, because of inadequate adhesion.

Power requirements for installations now being evaluated range from 0.5 to 2 watts/sq. in. with resistances ranging from five to 20 ohms.

Limited production of Sierracote is presently under way and the coating material is available in sizes up to 30x48 in. from Sierracin Corp., 1121 Isabel St., Burbank, Calif.



AVIOLANDA AT-21 is the Netherlands' first pilotless aircraft and was designed for multipurpose role as a target, radar trainer and avionic liaison craft. Fuselage front and rear sections, wings and tail are of plastic construction with foam plastic filling the aerodynamic surfaces. Powerplant is a special French Snecma pulsejet mounted under the fuselage and developing a maximum of 190 lb thrust. Plane is launched by rocket catapult or from a runway with a trolley landing gear. Control during flight is by radio command link from a ground cockpit with scope presentation of course, altitude and speed. Landing follows fuel cutoff by radio and is accomplished by a pair of parachutes.

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Missile Engineering

Russian Approves U. S. Satellite But Says He Can Build Better One

A leading Russian scientist has approved published U S plans for building an artificial earth satellite (AW Oct 10, p 7) but suggests that his country will be prepared to launch a bigger and better cosmic ball ' soon afterwards

Writing in a semi-monthly Moscow Journal, Professor Kirill Stanyukovich of the USSR Academy of Sciences Commission on Inter-Planetary Communication reports that Russian engineers ' believe it is possible to build larger satellites than those now being discussed in the Western press He adds

"There is every reason to hope that the Soviet earth satellite project will be realized in the not so distant future "

Stanyekovich Approves

His article in the political journal, the News," said that the present level of automatic and remote control engineering makes "entirely practical" the American idea of a composite two-stage rocket which can climb to a height of 250 miles, come to a stop at its maximum altitude and, at this precise moment explode from its side an 18-inch-diameter satellite having an initial velocity of about five miles per second

This sphere would be equipped with apparatus for measuring cosmic radiation solar radiation and intensity of the ferro magnetic field recording various phenomena in the underlying strata of the earth's atmosphere and transmitting the data to the earth

The Soviet doctor of technical sciences observed that such a satellite can be given an initial speed of five miles per second in two ways

"A three-stage rocket the satellite being the third stage, could be constructed But this is extremely complicated

The simpler way is to shoot out the cosmic ball with an explosion which will at the same time break up the remainder of the rocket and make its dissipation more probable

Calculations show that in order to obtain such a speed with the use of the powerful explosives T N T or hexogen, the weight of explosive has to be ten times that of the body to be ejected What is known as a directed explosion in which the energy is used in a particular direction, may be employed

' It is, of course, difficult to say now which method scientists in different countries will choose Both methods, it seems to me, are valid "

Stanyukovich said that if the satellite describes a meridional course from pole to pole (it can be made to follow any course desired), it will travel the total length of the meridian or about 25,000 miles, in 90 minutes. It will thus revolve about the earth 16 times every 24 hours

Spirol Towards Earth

At 250 miles altitude the density of the air is insignificant Still, air resistance will gradually slow down the satellite and make it lose altitude In the course of scores and hundreds of orbits it will gradually spiral down towards the earth.

What would happen next to a satellite of this kind? Would it reach the earth? Would it represent a danger to life or buildings on our planet?

'Numerous observations of meteorites, which enter the earth's atmosphere traveling at a speed of from six to 45 miles per second, show that the fastest become incandescent at a height of not more than 80 miles Slow meteorites become incandescent at a height of less than 60 miles

"At high altitudes the bombardment of meteorites by air particles is insignificant because of the low density of the air For this reason there is no intensive radiation that might produce a noticeable incandescence

'That is why the altitude chosen for the satellite is more than 125 miles where the rarefied atmosphere will not heat it up But since in the course of its spiral movement towards the earth the density of the air will increase the satellite will at a height of about 60 miles dissipate like a meteor

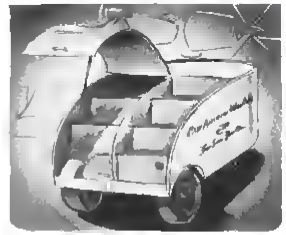
"It will probably be possible to observe this with the naked eye"

Navy and Small Business

Navy contracts awarded to small business firms totalled $750,100,000 for Fiscal 1955.

This represented 73.8% of procurements determined to have been within the small business production potential For the year, Navy purchasing totalled $8,821,747,000.

Navy reports that in the last six years small business firms secured $6,740,000,000 of the $32,958,000,000 spent. Percentagewise, small business had a share of 20.4% of the contracts awarded during the period



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Aero Supply Mfg Co. Inc of Corry Pa.. announces a series of general engineering data bulletins of a non-advertising nature prepared by Aero Supply's Research and Development Center recently established in Cleveland Ohio. The bulletins consist mainly of technical data with charts graphs and other valuable information related to the design of aircraft, rocket and missile fuel systems

The first four bulletins show viscosity vs temperature data for approximately 120 different fluids and has been prepared for availability on or about September 9 1955 Subsequent bulletins will appear at approximately one month intervals.

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This is the first generator that is completely integrated with its drive, with the engine oil cooling system and with the balance of the electrical system. It is completely enclosed, there are no air tubes or ducts to occupy space and clutter up the airframe, all external oil seals are static and there is no overboard drainage of oil. No additional plumbing is required because the extension of the engine oil lubricating system is all internal. Now—aircraft altitude and speed will no longer be limited by the electrical system—a big step toward helping you bring tomorrow's aircraft . . . one step closer. J-91024-B

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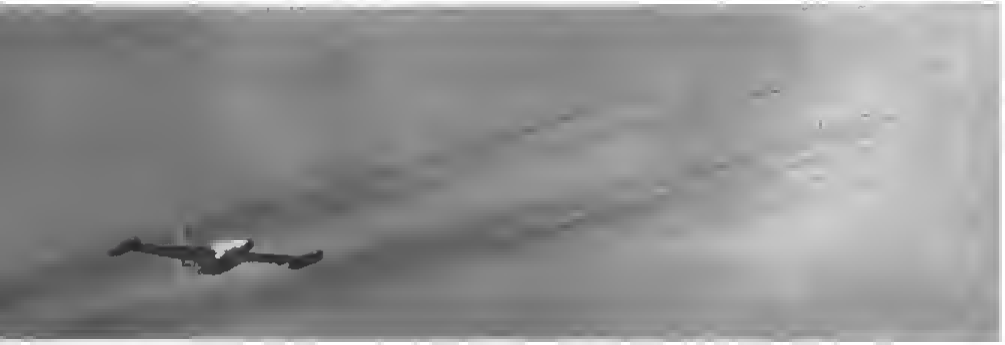
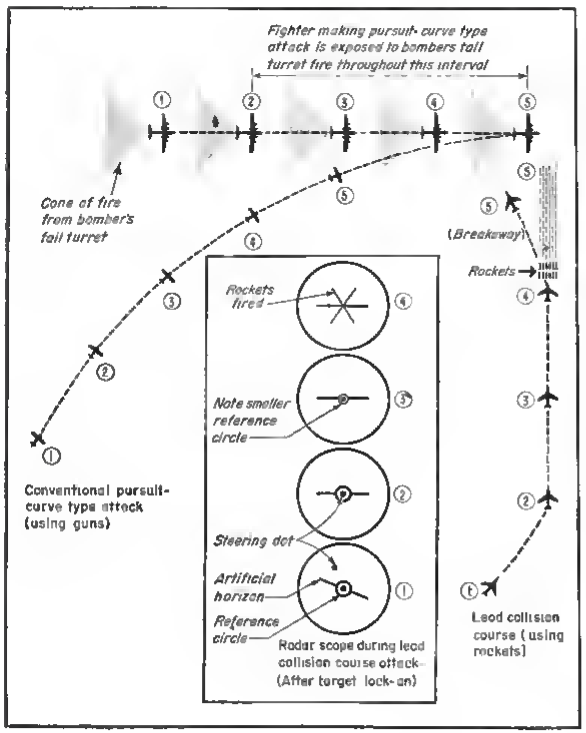


Avionic Tactic

Sharpens USAF Eye for Air-to-Air Kills



By Philip J. Klass

Culver City, Calif.—A USAF interceptor's kill probability against an enemy bomber has been greatly increased (possibly by a factor of up to 10) by a recent innovation in aerial tactics known as "lead collision course interception." The tactic enables an interceptor to attack a bomber from its most vulnerable broadside position, while remaining outside the bomber's deadly cone of tail turret fire.

The new technique, sometimes referred to as "thunderbolt geometry," is now in operational use in all Air Defense Command interceptors. It has been made possible by the mass lethal power of aerial rockets in combination with radar-directed fire control systems developed and built at the Hughes Aircraft plant here.

Lead collision course tactics replace the long-used lead-pursuit attack employed by gun-equipped fighters. An adaptation of the new technique will be used when air-to-air missiles, such as the Hughes Falcon (GAR-1), come into operational use in the near future (AW Oct. 17, p. 14).

Rifle vs. Shotgun

The old curve-of-pursuit tactic is required for a machine-gun equipped fighter which must generally lay in a "lot of lead" to bring down a bomber. This is even more true today than in World War II because of the rugged construction of jet bombers.

To do this, the gun-equipped interceptor must maintain itself in firing position for an extended period of time to allow the accumulated build-up of damage to reach lethal proportions.

This means that the interceptor must either make a head-on attack (which is extremely difficult to execute and gives only a brief firing interval) or fly a lead-pursuit curve, always pointing ahead of the bomber. This maneuver brings the interceptor curling in on the bomber's tail where it is subject to tail turret fire over an extended period (see sketch).

Even when the interceptor shoots explosive cannon shells it is essentially firing a high-speed rifle.

However, the postwar development of explosive aerial rockets, which can be fired in a single salvo, has given the interceptor a shotgun blast with each "pellet" packing a lethal punch. (The F-86D carries 24 rockets; the F-94C 48 and the F-89D 104.)

Broadside Attacks Possible

The rocket-equipped interceptor needs to be brought into correct firing position only for a brief instant, which increases the feasibility of making broadside attacks on a bomber. This not only gives the interceptor a much larger area at which to shoot but also keeps it out of the bomber's defended tail cone.

This in itself raises new problems, however, because it requires considerable piloting skill (and luck) to estimate and execute the proper maneuvers to bring an interceptor into a broadside firing position against a speedy bomber.

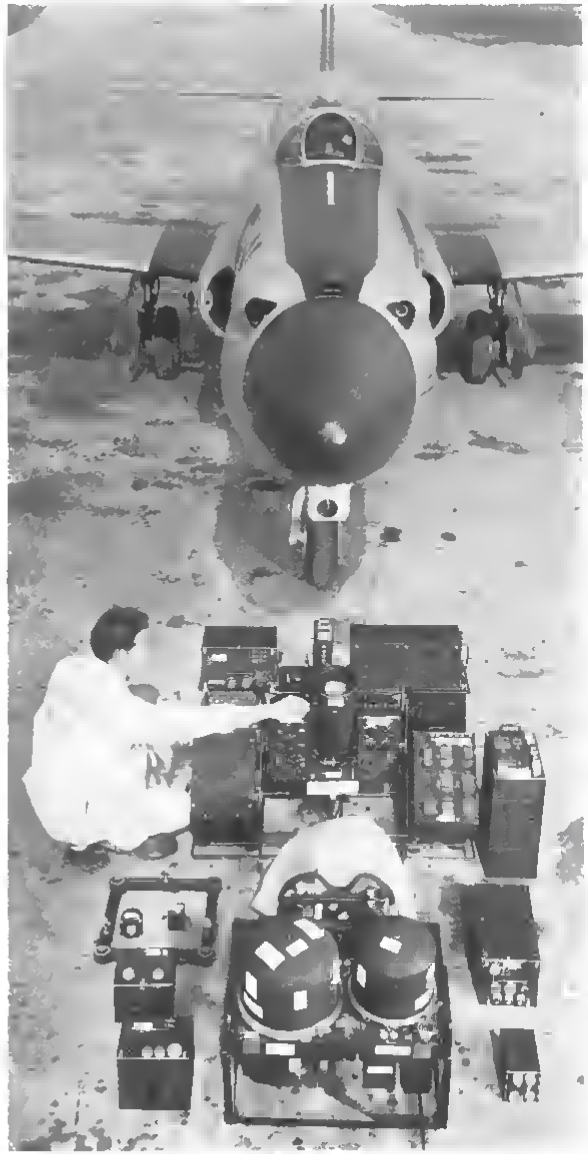
During World War II, the Germans effectively deployed rockets against our B-17 formations in broadside attacks by flying large numbers of Me-262's side-by-side in order to fire a sort of super-barrage. This technique today is considered wasteful and probably would be much less effective against the widely dispersed bomber formations now employed.

Avionics Needed

When the theoreticians first came up with the idea of a lead-collision attack around 1949, they were not at all sure that it could be made to work. (The tactic is called "lead collision" rather than "collision" course because the rockets travel faster than the interceptor, making the point of rocket-bomber collision several hundred yards ahead of the interceptor.)

One critical problem, for example, was timing. If the interceptor fired its barrage of rockets a split second too soon or too late, they would miss the bomber completely, and the interceptor would have expended all its fire power.

This critical timing, as well as the problem of determining the proper



HUGHES FIRE CONTROL SYSTEM, enabling the F-86D to automatically locate and track down an enemy target by day or night, illustrates growing amount of avionics equipment aboard a modern interceptor. More advanced system is under development for F-102A.

NEW "lead collision" attack (right) makes interceptor less vulnerable to enemy guns.

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Transmitter	CGC 8 A 7	Rotor 1 Phase	26	100	50	54 ∠80	37 0	Stator 3 Phase	11 6	12 ∠45	15 ∠35	11 8	8	200	7
Control Transformer	CTC 8 A 1	Stator 3 Phase	11 8	90	230	28 ∠110	20 7	Rotor 1 Phase	23 6	220 ∠740	245 ∠60	143	8 5	480	7
Control Transformer	CTC-8 A-4	Stator 3 Phase	11 8	37	.091	67 ∠270	58 5	Rotor 1 Phase	20	505 ∠1600	640 ∠180	361	9 2	480	7
Resolver	CSC 8 A 1	Stator 2 Phase	11 8	84	260	38 ∠136	27 0	Rotor 2 Phase	23 2	280 ∠600	380 ∠75	230	11	400	7
		Rotor 2 Phase	26	19	430	200 ∠600	230	Stator 2 Phase	10 6	38 ∠136	70 ∠28	27 0	28	180	7
Repeater	CRC-8 A 1	Rotor 1 Phase	26	100	50	58 ∠80	37 0	Stator 3 Phase	11 6	12 ∠45	15 ∠35	11 8	8	200	30
Differential	CDC 8 A 1	Stator 3 Phase	11 8	85	21	27 ∠120	25 0	Rotor 3 Phase	11 8	38 ∠122	47 ∠14	36	9	200	7 Rotor 7 Stator

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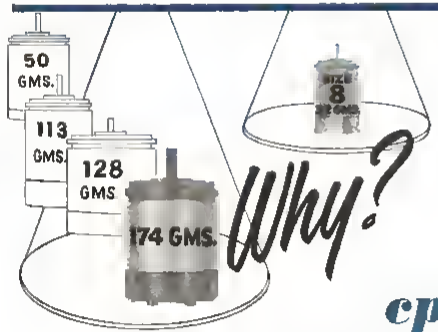
Torque 2600 ma mm degree from CGC 8 A 7



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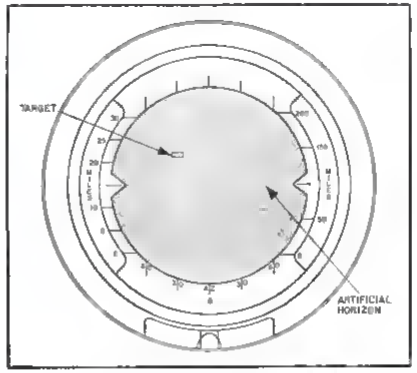
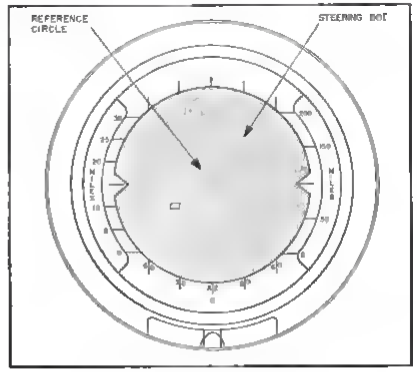


Scope display during search operation.



Scope display for the attack

course to fly the interceptor into the proper position, was not something that could be left to the frailties of human judgment. It had to be done automatically.

Fortunately, Hughes Aircraft already had developed a fire control system for gun firing interceptors which had the necessary basic ingredients for a lead collision attack. It had a radar which could pick up a target 10-15 miles away and lock onto it. As the radar tracked the target it supplied data on the bomber's range, position and rate of movement (by means of rate gyros on the antenna) to a computer which calculated a curve of pursuit course for the pilot. Target position and interceptor steering information from the computer was displayed on a radar scope.

During 1950-51, an experimental Hughes system modified to compute a lead-collision intercept course was successfully flight tested and the principle was proven. By early 1954, the Air Defense Command had aircraft equipped with rocket fire control systems and began to switch from conventional gunnery to rocketry.

Typical Mission

Here is how the Hughes system operates in an F-86D (similar systems are used in the F-94C and F-89D but they carry a radar operator aboard).

As soon as the pilot becomes airborne, the ground-controlled intercept (GCI) operator gives him voice radio instructions on the heading and altitude which will bring him into the vicinity of the target.

Meanwhile the Hughes radar is scanning the skies looking for the target. Inside the cockpit, the pilot scrutinizes his radar scope. An illuminated line is sweeping back and forth across the scope in synchronism with the antenna's scanning.

When a target blip appears on the scope, its horizontal position relative to the center of the scope indicates its azimuth position relative to the interceptor's present heading. The target blip's vertical height on the scope shows its range (see photos above).

A vertical and horizontal scale along the edge of the scope show range and position in miles and degrees, respectively. An artificial horizon presentation also is shown on the scope to let the pilot know his plane's pitch and bank attitude.

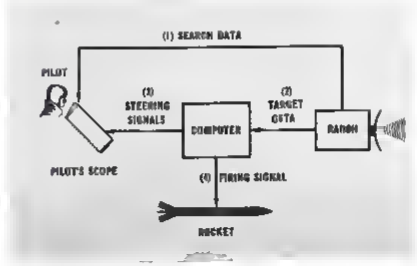
Once the radar has picked up the target the pilot takes hold of a small pistol-grip controller and positions the antenna until the vertical illuminated line on the scope is superimposed on the target blip. When he releases the controller, the radar antenna locks onto the target and proceeds to track it.

At the same time, the radar scope display changes to show steering signals for the pilot. All he needs to do to fly the proper lead collision course on the target is to maintain a small white steering dot centered in a reference circle (see sketch above right).

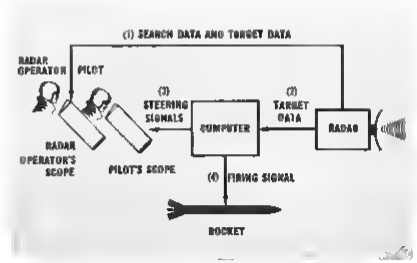
The position of the dot on the scope is controlled by the system computer. If the dot is to the right and above the reference circle the pilot banks right and pulls back on the stick until the steering dot enters the reference circle. He then maneuvers to keep the dot within the circle.

Twenty Seconds to Go

When the interceptor is approximately 20 seconds away from the point



One-man system



Two-man system.

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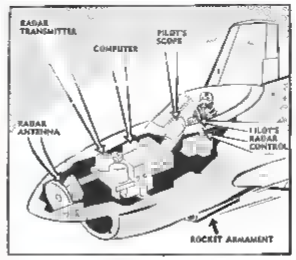


SCHEMATIC DRAWING shows installation of Hughes fire control system in an F-86D

of firing, the diameter of the reference circle begins to diminish in size. The pilot continues to fly to keep the steering dot centered. Approximately 15 seconds later if the pilot has done an acceptable tracking job and the computer determines that the attack is likely to be successful it flashes a suitable indication on the radar scope.

The pilot then squeezes the trigger on his control stick, which "arms" the system, but does not fire the rockets. The Hughes system initiates the signal which lowers the rocket pod. Then when the interceptor is in the correct firing position, the Hughes system fires the rockets in a ripple pattern.

As soon as the rockets have been fired, the reference signal and steering dot disappear, and a large "X" appears on the radar scope (see sketch p. 36).

The Hughes radar then can be used for ground mapping and navigation purposes during the interceptor's return to base. The pilot may never have seen the target.

F-86Ds are now being equipped with a device which makes the Hughes system more fully automatic. It is called 'control system tie-in,' or CSTI for short.

With CSTI, the computer output—in addition to being displayed on the radar scope—is fed to the plane's control surface actuators. This causes the interceptor to be automatically maneuvered onto the required lead collision course, keeping the steering dot automatically centered in the reference circle on the scope. In CSTI equipped interceptors, the pilot merely monitors the scope presentation after lock-on.

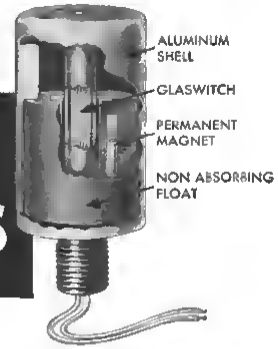
Falcon-Firing Interceptor

The CSTI-equipped F-86D is a forerunner of the early versions of the Convair F-102A which will be equipped with a new Hughes system, now in production, designed to shoot Falcon air-to-air missiles, as well as rockets.

In one sense, the use of guided missiles eases the accuracy requirements

REVERE

FLOAT SWITCHES



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now imposed on positioning a rocket-firing interceptor relative to the bomber under attack.

The missile has its own radar-directed guidance system which enables it to home on the bomber even against a maneuvering target.

However, the use of Falcons imposes some additional complexity in the new Hughes system.

Prior to launching the Falcon, the system must initiate and control a whole sequence of events within the missile. For example, the Falcon's gyros must be brought up to speed, its radar must be locked on the correct target, and, finally, its rocket motor must be started at the instant of launching.

In return for this added system complexity, the Falcon-firing interceptor gains a big tactical advantage. For example, the missile can be launched while the interceptor is well beyond reach of the bomber's defense. In addition, the Falcon can be launched while the interceptor is still far below the bomber's altitude.

Fully Automatic Interceptor

Later versions of the Convair F-102 will be truly automatic interceptors. They will be equipped with a very advanced fire control system, now believed to be nearing pilot production at Hughes Aircraft. The combination of the automatic interceptor and its guided missiles might be viewed as a two-stage, pilot-carrying missile with the aircraft itself forming the first stage.

The advanced system was first revealed by AVIATION WEEK more than two years ago (May 25, 1953, p. 15).

When this advanced interceptor is scrambled, it will go under automatic control of ground stations as soon as it becomes airborne. Information on attacking bombers (picked up by ground radars) will be fed in digital computers which will automatically calculate the optimum intercept flight paths for individual planes or groups of interceptors.

Instead of relaying this information to interceptor pilots over voice radio channels, it will be transmitted to individual aircraft by means of a pulse coded "data link." In the interceptor, the data link signals will be fed to the airplane's various control surface actuators.

This will enable ground stations to automatically vector the interceptor into the vicinity of the enemy where its airborne fire control system can take over. At that point, each interceptor cuts free from ground control and becomes a free agent.

When the interceptor has completed its attack, it may return to data link control. Ground stations then can navigate the interceptor back to its base.

XLO
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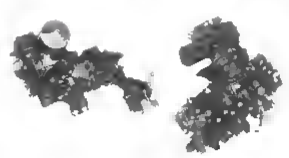
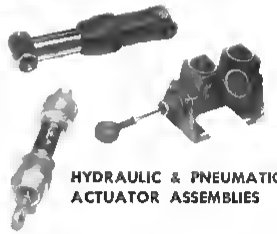
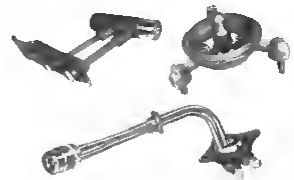
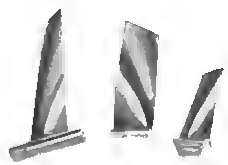

FUEL CONTROL AND METERING ASSEMBLIES


HYDRAULIC & PNEUMATIC ACTUATOR ASSEMBLIES


FUEL NOZZLES FOR JET ENGINES


JET ENGINE BLADES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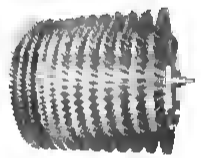
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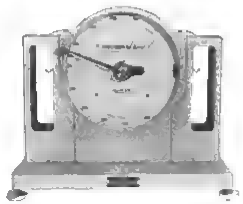

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Critics, Not Actors

The USAF, in describing the role played by its pilots in the present-day semi-automatic interceptor aircraft says:

"When the trigger is pulled, the men in the plane sit back as critics rather than actors in the drama, while the electronic (fire control) system actually decides the release time for the rockets."

In the Air Force interceptor of the very near future, the pilot will become solely a monitor of his avionics equipment for almost the full duration of the mission.

However, the supersonic creations of man's mind and his hands are fast exceeding human capability to engage these weapons in aerial combat. When this time comes, the pilots will remain on the ground, and avionics will take over completely.

FILTER CENTER

▶**New Name for Hughes?**—Qualified observers predict that it is only a matter of time before Hughes Aircraft Co. changes its name to reflect the fact that it is now primarily an electronics manufacturer.

▶**Antenna Selection Made Easy**—A new rotary slide rule which simplifies antenna design and application calculations is now available free of charge from Gabriel Electronics. Scales provide direct conversion between frequency and wavelength in both centimeters and inches; relation of power gain and db gain; relationship of wavelength, gain and beam width to antenna reflector diameter. Write A. Murphy, Gabriel Electronics Div., Needham Heights, Mass.

▶**Aero Communications Symposium**—The first Aeronautical Communications Symposium, covering both civil and military ground-to-ground and ground-to-air communications, will be held Nov. 21-22 at Utica, N. Y. The symposium is sponsored by the IRE's professional group on communications systems.

▶**Airborne Digital Computers in Production**—Hughes Aircraft Co., which pioneered the development of airborne digital computers, is now producing a model scheduled for use in its advanced interceptor fire control system for the F-102A.

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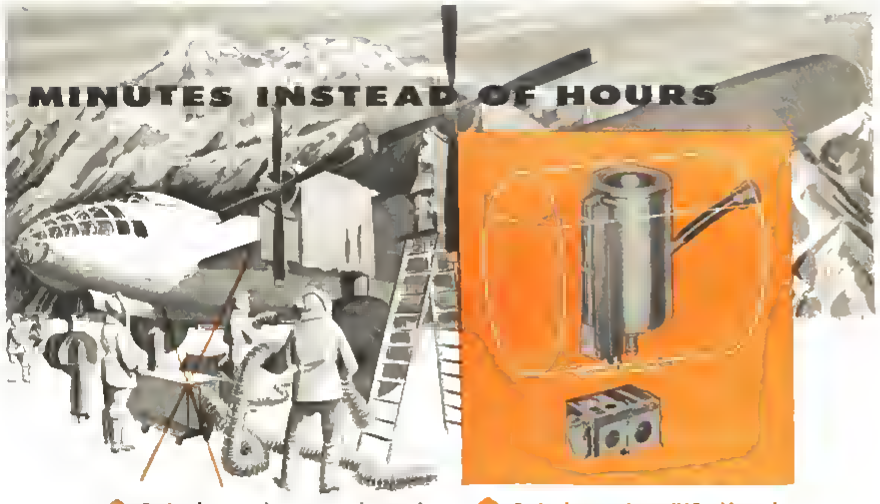

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One-Run, Throw-Away Spark Plug Ordered by AF, Eyed by Airlines

By George L. Christian

Toledo—One-Run, throw-away spark plugs are here to stay, industry and government representatives were told at this year's Champion Aircraft Spark Plug and Ignition Conference.

U. S. Air Force representatives reported that the one-run, throw-away plugs, which Champion has delivered to Westover AFB for use on a fleet of 20 Boeing KC-97 tankers, appear to work as well as the standard R-115 units formerly installed. Individual sets have run up to 35 hr. on the Pratt & Whitney R-4360 engines without unscheduled removals.

These plugs now cost 15% less than standard units. If they can be put into volume production, Champion claims the cost can be cut much lower.

The airlines are interested in the less expensive (some called it "de-glamorized") plug, mainly because of indications that it is built well enough to be reconditioned and used for more than one run. United Air Lines, Trans World and American each spend more than $200,000 a year on new spark plugs. Wright Aeronautical and Pratt & Whitney Aircraft, also, are evaluating these plugs.

Air Force Impetus

Development of the spark plug followed an Air Force request for a unit inexpensive enough to be discarded after one run. This would eliminate the cost and problems involved in reconditioning and inspecting thousands of plugs a year.

Here is how Champion "de-glamorized" the plug to make it less expensive:

- **Barrel is made of ⅞-in. hexagonal** stock instead of 1-in. round, reducing machining time and cost.
- **Insulator inside surface glazing** has been eliminated, reducing manufacturing rejects. Imperfect glazing has been a major cause of rejections.
- **Exterior plug** is painted, rather than plated. This eliminates the hand labor formerly involved in masking plug parts that were not be be plated.
- **Solid copper gasket** was replaced with a three-fold copper unit, producing a 35% cut in cost and a 50% saving in material. However, Air Force experienced some difficulty with the new gasket and Champion has temporarily gone back to the solid unit.

AC Spark Plug Division of General Motors also is developing a throw-away plug but has not delivered any to the military yet.

Jet Ignition

B. F. Paris of Wright-Patterson AFB, in a paper on gas turbine ignition, described an igniter with a constricted-type gap newly developed by Bendix Scintilla which promises to give more positive starts on jet engines. The spark fires along the plug's longitudinal axis toward the tip, thus tending to project itself into the combustion chamber and assure more positive firing. Present plugs fire radially between electrodes. The constricted axial type plug has not yet been tried in actual service.

Paris said ignition systems of the future must operate at temperatures ranging between +60-600F. Current operating temperatures are 250-300F.

Present ignition systems on most Air Force jets are capacitance discharge types which produce high voltage discharge at the igniter. Disadvantages are flashover at the plug and cable failure, also, muscovite mica used in the storage capacitor is a critical material.

So the Air Force has a program to develop a low tension exciter which will operate at 500F. and leads which will withstand 1,500F., Paris reported.

At present, igniter life is about 150 hr., although time varies considerably between engines. Main troubles are electrode burning and ceramic cracking due to the high thermal gradient present in combustion chambers.

Current and future work on plugs emphasizes development of shunted surface units for low tension condenser discharge systems. So far, low tension systems have been held back by the limited life of shunted surface plugs, Paris said.

During the last year, Scintilla developed a cuprous oxide coating on an aluminum oxide ceramic insulator, which can operate under extreme carbon, fuel and water fouling conditions and increases spark plug life.

Manufacturing Review

R. L. Anderson, aviation service manager for Champion, reported that his company has modified ground electrodes by broadening the tip and changing profile of the root to give 30% more erodable material. Use of denser cement between center electrode and insulator gives better heat transfer and a 70-80F. reduction in center electrode temperature.

Continental Airlines reported having spark plug fouling problems on planes flying the southern segment of its routes which do not exist in aircraft flying in the north. A Continental spokesman said: "If we switched the fleet around, the problem would still stay in Texas."

Trouble has been traced to sand and dust ingestion. Texaco said airborne sand (silicon dioxide) seemed to be the principal cause of aircraft plug fouling. Even a very small proportion of silicon combined with lead can be troublesome. It forms lead silicate which becomes fluid at 1,400F. and can splash onto a plug's electrodes, causing a dead short. Texas suggests changing plugs immediately after flying through dust concentrations.

Some Wright turbo-compound operators, including Eastern and KLM, are switching from Champion R103 plugs to AC285 fine wire units. Reason: the R103s foul, resulting in power loss at takeoff.

EAL said it went to the AC plug because analyzers showed no ignition pattern on the Champion plug during takeoff. The switch was done simultaneously with other engine modifications including change from rigid to flexible fuel injection lines, and change in tuning. The better condition of pistons and combustion chambers, therefore, may not be wholly attributable to the AC plug.

EAL, PAA and KLM reported one or more cases of center electrode failures on the AC285.

American, United and TWA, all of whom operate turbo-compounds with Champion R103s, registered no complaint about the plug.

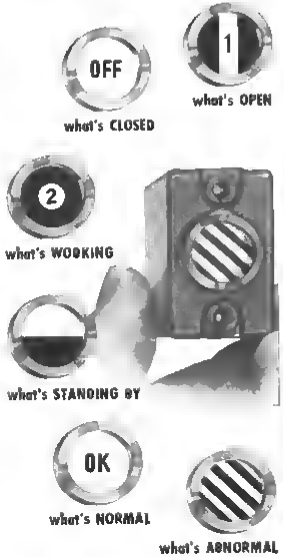
The AC285 costs about twice as much as the Champion R103.

On R2800s, United reported cutting aborted takeoffs 80% by reducing plug life from 600 hr. to 400 hr.

On Wright R3350DA turbo-compound engines, Champion R103 plugs sometimes have one ground electrode thinning out in service faster than the other three. It is believed that one prong gets hotter than the others because of uneven heat flow or localized heating caused by air flow in the combustion chamber. It was suggested that changing the engine's spark advance from 35 to 30 degrees at cruise would help alleviate this condition.

To eliminate gas seepage in R103 plugs, Champion is investigating two fixes: hot-locking the plug's copper sleeve and applying silicone to inner and outer bore of the copper sleeve.

HERE'S HOW YOU CAN TELL



THE KEYSTONE 3-POSITION INDICATOR at present is being used on aircraft to report more than 60 operating situations. Simple, easy to read, hermetically sealed, reliable, it will report *any* variable that can actuate a switch mechanism.

Conforms to spec MIL-I-6839, Landing Gear Position Indicator. Send coupon for complete information.

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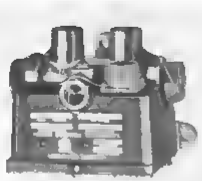


Differential Pressure Switch

Differential pressure switch is adjusted at neutral for normal condition between two systems operating at the same or different pressures. If unbalance occurs on either line, the AL 58N dual sensing switch can detect it, determine the direction of the deviation and actuate a corrective feed back action.

The switch also actuates warning lights in aircraft equipped with two pump hydraulic systems.

General Controls, Glendale, Calif.

Flexible Gear Boxes

Flexible precision made gear boxes have wide range of gear ratios from 4:1 to 12,000:1. Available in Series 145 and 167, weights range from 2¾ to 5 oz. Series 145 provides up to 150 in.-oz. of torque; series 167, 200 in.-oz.

Gear boxes are designed for mounting directly to small electric motors and also can be supplied with an input shaft. Applications include servo mechanisms, computors, small actuators and electronic components.

Precision ball bearings are used to provide high efficiency. Sealed, permanently lubricated bearings are used on the output stage. The units also are available in standard Bureau of Ordnance sizes 15 and 18.

Southwestern Industries, 5880 Centinela Ave., Los Angeles 45, Calif.

Stand Provides Multiple Power

Multipower source stand, said to simulate any combination of aircraft electrical conditions, can be used to check relays, solenoid valves, radio and radar receivers and transmitters.

A completely packaged unit, it provides the following types of variable voltage: 5 to 32 v. d-c with 200 amp. maximum; 60 cycle from 0 to 135 v. with 20 amp. maximum; 95 to 135 v. with variable frequency from 380 to 420 cycles.

Industrial Engineering Corp., 525 E. Woodbine, Louisville 8, Ky.

Dual-Purpose Anti-Icing Valve

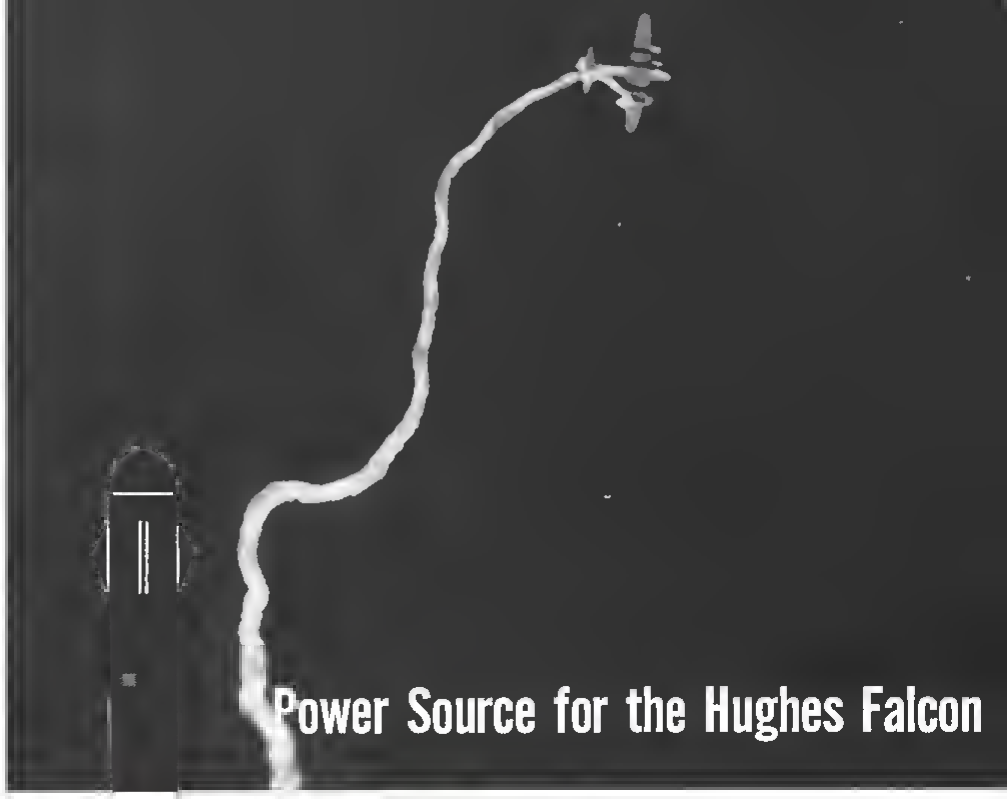
Developed to control a jet engine anti-icing system, this hot air shutoff and pressure regulating valve is a self-regulating modified globe valve that withstands temperatures of over 1,000F inlet and 500F ambient.

The unit, Part No. 35079, holds downstream pressure constant with inlet pressure varying over a wide range. Its secondary function is to act as a shutoff and check valve. It opens or closes by remote control of a solenoid operated bleed valve which overrides the action of the pressure regulating pilot.

Hydro-Aire, Inc., 3000 Winona Ave., Burbank, Calif.

'Vacuum Cleaner' Clears Runways

Aerodeck suctions rainwater from flooded runway after a storm at Vickers-Armstrong's airfield at Weybridge (Surrey). Machine is manufactured by Cimex-Fraser Tuson, Ltd., Orpington, Kent, England.



. . . a Thiokol® solid propellant rocket

The Falcon, designed and built by Hughes Aircraft for the United States Air Force, is one of the smallest air-to-air guided missiles in production. It is launched from interceptor planes and is capable of pursuing and destroying enemy bombers taking evasive action.

The power required to launch and propel the Falcon from an interceptor is supplied by a "Thiokol" solid-propellant rocket motor.

Development of the Falcon motor is the result of close teamwork between Thiokol, Hughes Aircraft and the Armed Services. Thiokol is also engaged in other programs that provide our Armed Services with improved solid propellant rockets adapted to specific operational requirements.

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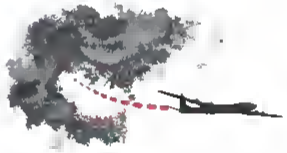
More and More Leading Air Lines are installing RCA's New Weather Radar

Dotted line shows how airplane passed between storm cells in its flight path.



Minutes and miles are saved when a pilot is able to find a smooth path through turbulent areas.

AVQ-10 antenna mounted in nose of airplane scans the forward area, enabling the pilot to evaluate storm conditions far ahead.

Simplicity, light weight, efficiency and dependability are the reasons for this preference

More and more leading air lines are equipping their ships with RCA's new weather-mapping radar. Their choice has been based upon exhaustive comparisons.

RCA's AVQ-10 is the first airborne radar to use C-Band (5.6 cm) transmission, the wave length most suitable for "looking into" storms, yet having the least amount of scope clutter. It presents the pilot with an easily-interpreted display of storm conditions around him. In addition, it gives the pilot valuable ground-mapping information.

In terms of time saving and increased passenger comfort, the RCA AVQ-10 weather radar is more and more becoming a "must" among air lines. With it, pilots can "see" into storm areas many miles ahead and pick non-turbulent paths between them, often making long and costly detours unnecessary.

RCA is proud that these distinguished air lines have chosen the AVQ-10 to save time and increase passenger comfort. Every effort will be made to meet additional commitments occasioned by the great and growing demand for this equipment. To assure early installation, other air line and private operators are invited to write immediately for further particulars on the RCA AVQ-10. Overseas customers should get in touch with the RCA International Division, 30 Rockefeller Plaza, New York City, or any RCA International Distributor.

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Bondolite honeycomb construction. Epon Adhesive VI bonds aluminum skin to central aluminum honeycomb.

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New Epon adhesives are being specified to replace expensive riveting and welding in an ever increasing variety of aircraft applications. Because they contain no solvents, Epon adhesives permit immediate assembly of metal-to metal bonded parts. Contact pressure alone is all that is required to form sound bonds. Surfaces before bonding need not be machine-finished and glue lines need not be uniform. Air-relief drilling is never needed.

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- EPON ADHESIVE 422. A special formulation in tape form for service at temperatures up to 600 F.

Epon adhesives have been used successfully in bonding metal, plastics, rubber and wood for helicopter rotor blades, honeycomb wing sections, jet fuel tanks, radar antennae, structural joints and floor panels. Can Epon adhesives solve an assembly problem for you? Write us about your problem and we'll send full technical information and samples.

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ALSO ON THE MARKET

Overvoltage protection relay can be incorporated into any aircraft ac electric system or panel. The relay is 2.38 in. long, 0.383 in. in diameter and weighs 0.177 oz. It does not require rectifiers or stand-by power.—Jack & Heintz, Inc., 17600 Broadway, Cleveland 1, Ohio

Silicone lubricants for jet aviation and industry have an operating temperature range from —100 to over 400F. Versilube F-50 and G-300 lubricants are currently being used in tests on jet aircraft components.—Silicone Products Dept., General Electric Co., Waterford, N. Y.

Miniature electro-magnetic clutches and brakes weigh 2¼ oz., are less than 1 in. in diameter, consume 2 watts of power, and deliver 30 in. oz. of torque. Size 100 clutches and brakes can be used at speeds to 4,000 rpm., response time ranges from 10 to 15 ms.—Dual Products Co., 9 Avenue E., Bayonne, N. J.

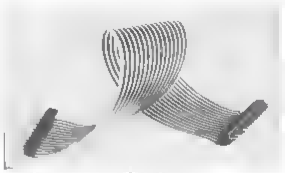
Low range flow sensor measures flow over a range from .07 to 0.7 gpm. The unit produces an ac output signal whose frequency is directly proportional to flow and can be used with a digital counting or computing system or with an electronic frequency converter. Units are available for operating at temperatures from —300 to 450F.—Potter Aeronautical Co., Route 22, Union, N. J.

Type B Hunlight uses a graded circumferential tube light arrangement which places the camera lens inside the light source, thereby producing shadow-free photographs for laboratory and engineering applications.—Hunlight Corp., 2500 John St., Fort Wayne, Ind.

Black Knight surface sealer is said to prevent softening and disintegration of blacktop surfaces due to attack by oils, greases, gasoline, jet fuel and weather. Available in charcoal, green and red.—Maintenance Engineering Co., 16 W. Johnson St., Philadelphia 44, Pa.

Mobile die tryout presses, available in models of 50 or 75 ton capacity, can be operated either airdraulically or hydraulically. Head can be released and rotated up to 240 deg.—Alpha Press and Machine Inc., 9281 Freeland Ave., Detroit 28, Mich.

High-pressure bottle cart, originally designed to provide an air source for starting jet aircraft engines in areas remote from standard sources, supplies high pressure air for any purpose. The unit is 42 in. high, 38 in. wide and 60 in. long, weighs approximately 2,000 lb., and has a capacity of 18,000 cu. in.—Dehumidifier 4SCFM is 18 in. wide, 24 in. deep and 30 in. high, has input air temperatures up to 150F. The unit also dehumidifies gases of all types and may be used to cool liquids.—Accessory Controls & Equipment Corp., 146 Willard Ave., Newington, Conn.



Flexible printed circuit cables are made by laminating plastic Kel-F with copper in thin sheets for light weight. Additional conducting and insulating layers can be added to the basic cable, depending on the application.—Sanders Associates, Inc., Nashua, N. H.

Setting dummy hands on a new 8 day aircraft clock, AN1MB, keeps track of estimated time of arrival. One set of dummy hands is painted on the crystal while the other is attached to a center knob which can be moved.—Waltmann Watch Co., 15 W. 47 St., New York 36, N. Y.

Bakelite fluorothene water jacket adapter on 300-amp Heliarc welding torch resists surface temperatures as high as 400F without distortion or leakage.—Linde Air Products Co., 646 Frelinghuysen Ave., Newark, N. J.

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The V-10 Camera is specially designed and built for all applications where essential data can be recorded photographically. It is not just another "movie" camera with modifications. The V-10, therefore, has features not found in other units. For example: (1) Fewer working parts. (2) Faster, simpler loading and unloading. (3) Compact, requires only 1/5 cu. ft. space. Room for Intervelometer *inside* case. (4) Film travel either up or down. (5) Double frame picture size optional. (6) Can be converted into a projector easily and quickly. (7) Remote film indicator switch.

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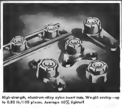

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How Alcoa helped ESNA* cut weight of aircraft stop nuts 60%

Because of exceptional strength requirements, high-strength steel aircraft bolts have traditionally required steel nuts. ESNA engineers called in Alcoa. Would we work with them in developing a high-strength lightweight aluminum stop nut? Several high-strength aluminum alloys were tested in different tempers Shear, torsion and corrosion exposure tests were conducted In all, 672 tests including 158 microscopic examinations and 70 solution potential measurements were made to verify the high resistance to corrosion. ESNA with the assistance of Alcoa's Aluminum Research Laboratories came up with a complete line of aluminum alloy stop nuts ¼" and smaller which met AN-365 and AN-366 tensile requirements

The result?... ESNA Blue J fasteners saved 30 lbs on the Douglas A4D Skyhawk attack bomber. On a plane the size of a B-36, they would save several hundred pounds.

ESNA's exacting requirements of high strength, lightness and corrosion resistance may differ from yours But experience gained from thousands of such projects is available through Alcoa's Aluminum Research Laboratories. Helping to make your product perform better in aluminum could be our next job. Contact your nearest Alcoa sales office Aluminum Company of America, 1800-K Alcoa Building, Pittsburgh 19, Pa

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Stock Sales Reported

Disposal of 10,900 common shares by Robert M Love, director of Allegheny Airlines, Inc., leaving a holding of 8,500 has been reported by the Securities and Exchange Commission

Other transactions reported for the mid-August to mid-September period were

ACF Industries Inc Acquisition of 112 common shares by Charles J Hardy Jr director making a holding of 1139 disposal of 100 shares of 5% cumulative convertible preferred total holding by Charles J Hardy Jr director

Aero Supply Mfg Co Inc. Acquisition of 1400 common shares by Henry M Margolis, director making a direct holding of 15 700 and an indirect holding of 4 000; acquisition of 4000 common shares by Leo Strauss director making a direct holding of 7 591 and an indirect holding of 4 900

American Airlines Inc Disposal of 6 000 common shares by C R Smith president and director leaving a holding of 35 000; disposal of 2 000 common shares by Mervin Whitlock officer leaving a holding of 500

Avco Mfg Corp Disposal of 1 500 common shares by James D Shouse officer and director leaving a holding of 4 050

Bendix Aviation Corp. Disposal of 200 common shares by Charles Hummel officer leaving a holding of 570

California Eastern Aviation Inc Acquisition of 200 common shares by Jorge Carnicero beneficial owner and director making a direct holding of 116 590 and an indirect holding of 35 322 acquisition of 2000 common shares by William E. Cunningham, director making a holding of 114 600 disposal of 1700 common shares by J W M Haight, officer and director leaving an indirect holding of 5 000 acquisition of 4 770 common shares by Edward A Kerbs director making a direct holding of 11 000 and an indirect holding of 1 120

Capital Airlines Inc Acquisition of 500 common shares by Crawford Johnson, Jr, director making a holding of 1 205 acquisition of 200 common shares through exercise of option by Charles H Murchison director making a holding of 20 600 disposal of 2 000 common shares by Thomas D Neelands, Jr, director, leaving a holding of 5 025

Chance Vought Aircraft. Acquisition of 500 common shares by Frederick O Detweiler officer and director, making a holding of 1 000 acquisition of 300 common shares by James J Guffary officer making a holding of 400 acquisition of 100 common shares by H S Salleda officer and director making a holding of 200 acquisition of 300 common shares by Newton V Turney officer and director making a holding of 300

Continental Air Lines, Inc Acquisition of 400 common shares by Frank H Rickelson Jr director making a holding of 5 400

Eastern Air Lines Inc Disposal of 300 common shares by Stuyvesant Peabody Jr director leaving a holding of 200

General Electric Co Acquisition of 2 136 common shares by Walter R G Baker officer making a holding of 6 072 acquisition of 400 common shares by John Holmes director making a holding of 1 000 acquisition of 2 100 common shares by Donald L Millham officer making a holding of 4 700 acquisition of 1 213 common shares by Ross I Parker officer, making a holding of 1 440 disposal of 400 common shares by Sidney J Weinberg director, leaving a direct holding of 1,500 and an indirect holding of 400

General Dynamics Corp Disposal of 5 000 common shares by J Geoffrey Notman officer and director, leaving a holding of 2 410

Goodyear Tire & Rubber Disposal of 1 375 common shares by R P Dinsmore officer leaving a holding of 3 390 acquisition of 237 common shares by Edward B Greene, director making a holding of 2 007 acquisition of 111 common shares by J C Hunsaker director making a holding of 1 592 disposal of 1 000 common shares by Howard L Hyde officer and director leaving a holding of 5 475 acquisition of 100 common shares by J P McWilliams, director, making a holding of 1 100

Kaiser Aluminum. Acquisition of 3 240 common shares through exercise of option by Chad F Calhoun, officer making a direct holding of 6 745 and an indirect holding of 5 470 565; acquisition of 4 500 common shares by R A Cinglos officer making a holding of 5 420

Lear Inc Disposal of 400 common shares by F D Bremer officer, leaving a holding of 0

McDonnell Aircraft Corp Acquisition of 1 000 common shares by Garrell C Covington Jr officer making a holding of 1 580

Northrop Aircraft Inc Disposal of 3 000 common shares by Edgar Schmued officer leaving a holding of 400

Pan American World Airways Inc Acquisition of 500 capital shares through exercise of option by Henry H. Berke officer, making a holding of 1 505 acquisition of 366 capital shares as compensation and 1 500 through options by Willis G Lipscomb officer making a holding of 4 502

Philco Corp. Disposal of 200 common shares by Larry F Hardy officer leaving a holding of 6 604

Radio Corp of America. Acquisition of 100 common shares by Robert L. Werner, officer making a holding of 440

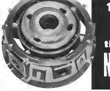
Solar Aircraft Co Acquisition of 100 common shares by John M Dolan officer total holding

Sperry Rand Corp Acquisition of 120 common shares by Bernard O Brucher officer making a holding of 10 734

Thompson Products Inc Disposal of 900 common shares total holding by E M Jones officer disposal of 2 500 common shares by J D Wright officer and director leaving a holding of 10 518

United Aircraft Corp Acquisition of 400 common shares by William R Robbins, officer and director making a holding of 2 800 acquisition of 5 000 common shares by H Mansfield Horner president and director making a holding of 8 000

Westinghouse Electric Corp Acquisition of 1 000 common shares by E V Huggins officer making a holding of 2 124



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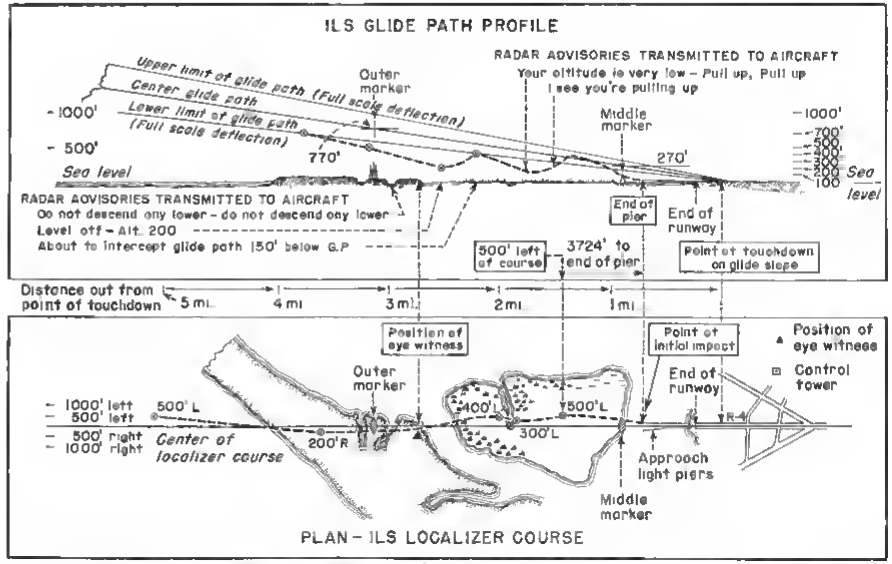

PROBABLE FLIGHT PATH and positions of LAI flight 451 during last, and fatal, approach to Runway 4 at New York International Airport on Dec. 18, 1954. Information is based on data obtained from transcription of radar advisories.

Official CAB Report on Italian DC-6B Crash at Idlewild

Pilot Fatigue Caused Erratic Approach

The Accident

At approximately 1400, December 18, 1954, an Italian Airlines DC-6B, Italian registry I-LINE, crashed into the pier which supported the left row of ships' line approach lights to runway 4 at the New York International Airport (Idlewild). The accident occurred during the flight's fourth instrument approach to the airport.

The entire crew of 10 and 16 of the 22 passengers were killed. 4 of the 6 survivors received serious injuries.

The aircraft was demolished by impact and sank in Jamaica Bay. An intense fuel fire followed the impact and spread over the water surface and pier.

History of the Flight

Flight 451 is one of four Italian Airlines flights scheduled weekly over the North Atlantic between the Rome-Ciampino Airport, Rome, Italy, and the New York International Airport, Jamaica, New York, with scheduled intermediate stops at Milan, Italy; Paris, France; Shannon, Ireland; Gander, Newfoundland (technical stop); and Boston, Mass. Scheduled elapsed time for the flight is 23 hours and 50 minutes, of which 20 hours and 45 minutes is flying time.

Flight 451 of December 17-18 departed Rome at 1810 GCT (Greenwich Civil Time) December 17, 1 hour and 10 minutes behind schedule because of a late connecting flight.

The multiple flight crew of 10 consisted of Capt. Guglielmo Vigarolli, First Officer Vittorio Bortignoni, Second Pilot Francesco Miraglia, Second Pilot Accardo Bracchi, First Flight Engineer Umberto Cichi, Second Flight Engineer Ernesto Leone, Radio Operator Mario Parodi, First Steward Giuseppe Brackbauer, Second Steward Antonio Faghabini, and Hostess Ileana Pozzuoli.

The stops at Milan and Paris were canceled because of local ground fog, and the flight reached Shannon at 2320 GCT. There the aircraft was refueled and checked.

Flight over the North Atlantic was uneventful. Routine position reports were made, and the flight periodically received and logged en route and destination weather reports. This and the previous segments were described as very smooth, little or no actual instrument flight, and no apparent mechanical difficulties. Arrival and departure times at Gander were 0945 and 1038 GCT.

As the flight neared Boston, instrument conditions were encountered but were of little consequence, and I-LINE landed at 0928. Nine passengers deplaned, and the aircraft was serviced with 804 gallons of fuel, making the total fuel on board approximately 2,415 gallons, sufficient for about 7 hours of flight.

The crew filed an IFR (Instrument Flight Rules) flight plan with the Boston ARTC (Air Route Traffic Control) Center through TWA (Trans World Airlines), which performed under contract station operations functions exclusive of dispatch or control for the Italian Airlines. No alternate airport was specified in the information furnished TWA.

The aircraft was loaded to a gross weight of approximately 90,000 pounds, well under the maximum allowable of 107,000, and the

All times referred to herein, except where indicated otherwise, are Eastern Standard and based on the 24 hour clock.

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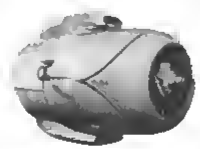

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load was properly distributed in relation to the center of gravity of the aircraft. The flight departed Boston at 1013.

After an uneventful instrument flight involving normal Air Route Traffic Control routing and control, Flight 451 reported at 1122 to the Idlewild Approach Control as being over the Mitchell Radio Range Station at 7,000 feet. The flight was then cleared to enter the Scotland holding pattern (located approximately 13 nautical miles southwest of the Airport) and was subsequently "laddered down" to the number one position to approach.

Between 1147 and 1159 weather conditions deteriorated below the ceiling minimums of 400 feet for landing on runway 22, the runway then in use. The flight continued to hold.

At 1159 reported weather conditions improved and CLINE was cleared for an approach to runway 22 using the back course of the fLS (Instrument Landing System). At 1218 the flight reported it had discontinued this approach. It was then issued missed-approach instructions and returned to the Scotland holding pattern. Shortly thereafter weather conditions were again reported below minimums for runway 22. They were then reported as: Ceiling 300 feet, broken, 2,500 feet, overcast, visibility 2½ miles, light rain and fog, wind south southeast 20 knots.

While holding, the flight was asked by Approach Control if it would be able to make an approach to runway 4, the fLS runway, considering the tailwind component. The flight accepted runway 4 and was cleared at 1307 for an fLS approach. At 1313 the tower was advised by 451 that the approach had been missed.

Abandoned GCA Approach

The flight was next offered and it accepted, a GCA (Ground Controlled Approach). This approach was abandoned at 1324, a missed-approach procedure was followed, and the flight returned to Scotland.

At 1327 the Italian Airlines Station Manager in a message relayed by the tower asked the flight its remaining fuel and received the reply that there was three hours of holding fuel. The Station Manager then suggested that the flight hold for 1½ hours and if unable to land to proceed to Washington, D. C. At 1329 the flight acknowledged this message.

At 1349 the flight was again cleared for an fLS approach, the third approach to runway 4 and its fourth to the airport. At approximately 1400 the aircraft struck the left pier. The impact was accompanied by a violent explosion and followed by an intense fire. Tower personnel immediately sounded the crash alarm and initiated emergency procedures.

At the time of the accident weather conditions were reported as: Ceiling 200, overcast, visibility 2½ miles, light rain and fog, wind south southeast 16 knots. Italian Airlines minimums for fLS approaches to runway 4 are ceiling 200 feet and visibility ¼ mile.

Investigation

An investigation at the accident scene disclosed the aircraft struck the left inbound

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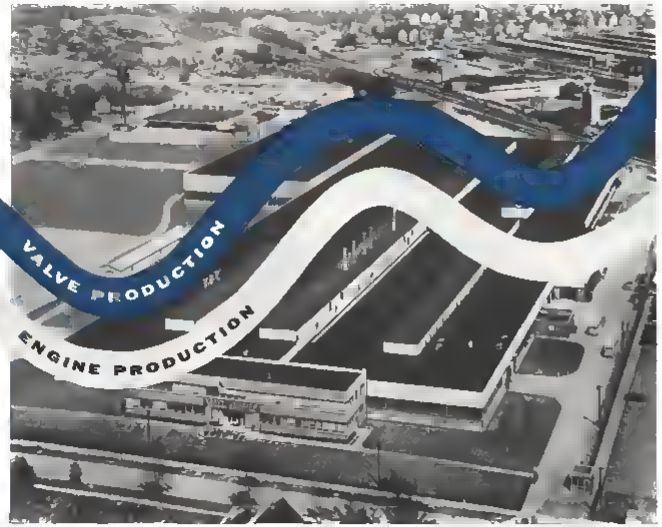

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pier. The pier, primarily constructed of heavy wooden piles, extended approximately 2,000 feet into Jamaica Bay with its offshore end 2,550 feet from the approach end of runway 4.

The floor of the pier was approximately 14 feet above the water level in the Bay at low tide. At the offshore end a vehicular turnaround was constructed of numerous piles forming each of its four corners, the tops of which were about six feet above the pier floor.

Hit East Half of Pier

First contact was with the pier only a few feet above the water. At impact the aircraft was moving nearly parallel with the pier toward runway 4. The impact shattered the east half of the end of the pier, breaking and splintering the tops of most of the 11 piles composing the southeast corner. The bulk of the aircraft wreckage then sank in approximately 30 feet of water mainly along the right side of the pier, over a distance of approximately 1,550 feet toward shore.

The nature of damage to the pier, its closeness to the water, and the fact that little wreckage came to rest near the point of impact indicated the aircraft struck without an appreciable rate of descent.

A propeller slash mark made by a blade of the number one propeller was found in the center pile at the offshore end of the pier. This cut disclosed that the number one engine nacelle was nearly centered with that position and the aircraft was slightly nose-up at impact. Thus propeller axis having been established made it apparent that the number two engine crashed into the southeast corner of the pier. Comparison of the heights of damage marks across the end of the pier revealed that the aircraft was nearly level laterally at the instant of impact.

Following the initial impact the left outer wing panel wrapped around the piling and shattered. The center section of this wing went forward above the pier deck, destroying several light installations before it veered off to the right.

At initial impact the fuselage was to the right side of the pier and thus the main portion of the aircraft continued on making additional contacts with the pier during this travel. These impacts disintegrated the right wing outer panel and forward fuselage. During this time number three and number four engines were torn out. As the remainder of the fuselage moved forward it turned approximately 180 degrees and when about 1,300 feet beyond the initial impact point it was moving backward.

Rescue Operations

The six surviving passengers were seated at various positions in the main passenger cabin. Two were able to extricate themselves from the wreckage and climb onto the burning pier but ahead of the fire, enabling them to proceed immediately to safety. The others were forced into the Bay and were rescued by a private boat operator or helicopters dispatched by the New York Port Authority, the New York Police Department, and the Coast Guard.

Smoke, fire, and the location of the accident presented great difficulty in rescue ac-

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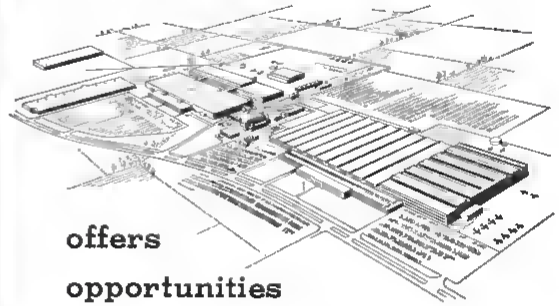

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crities however they were accomplished as quickly and efficiently as possible under these circumstances

Two areas of fire damage were evident in the wreckage however in both instances they clearly occurred following the initial impact

Recovery operations undertaken in extremely difficult conditions produced about 80 percent of the aircraft The wreckage was laid out for detailed examination the result of which disclosed no evidence of fatigue cracking structural failure or malfunctioning controls prior to impact

Examination of Wreckage

Examination of the components of the landing gear and flaps indicated that at impact the landing gear was fully retracted and the flaps were extended approximately 18 degrees

Maintenance records of the aircraft covering its entire service life showed that inspections were performed within the specified intervals all pilot complaints were corrected and required replacements due to service time had been made No repetitive discrepancies affecting airworthiness of the aircraft were found

Examination of the severely damaged ILS receiver and indicators disclosed no evidence of malfunction or failure prior to impact

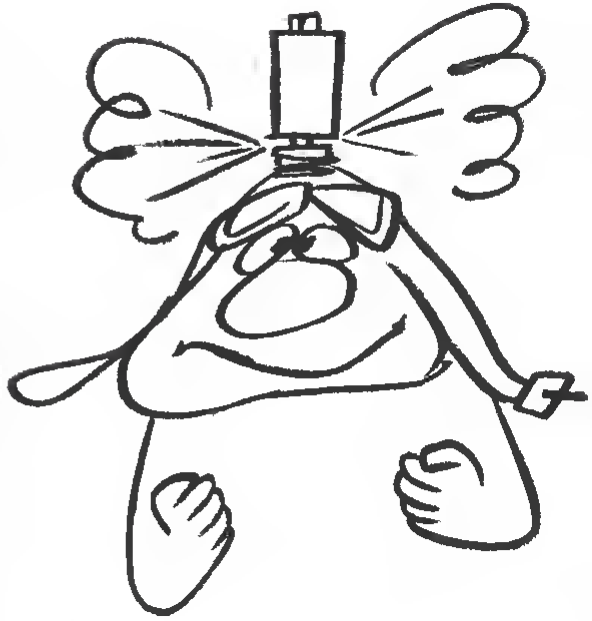
Only a portion of the number four engine was recovered which was insufficient to determine its operating condition Numbers one and two engines received severe impact damage from striking the pier Heavy cylinder damage to number one was confined primarily to the lower half whereas corresponding damage to number two was general around the entire engine The number three engine sustained water damage The power sections main oil screens and oil pumps from the engines did not disclose any evidence of failure or malfunction prior to impact Most other components and accessories disclosed severe impact damage characteristic of sudden deceleration

Only the numbers three and four propellers were recovered Most indicative of the power settings at impact were propeller cuts found in the pier made by the number one and number two propellers and the rpm setting of the governor of the number four propeller This evidence indicated appreciable probably takeoff power at impact

Testimony of Witnesses

Supporting the evidence of the structure powerplant and propeller examinations were the statements of surviving passengers one a pilot which indicated they did not hear or see anything unusual relative to the performance of the aircraft The crew at no time in the many radio communications made with various facilities en route and at the airport mentioned any difficulty

During the accident period a normal crew was on duty in the Idlewild tower located about one mile northnortheast of the approach end of runway 4 A two-way recording unit made a permanent record of the transmissions between flights and the various control tower positions A



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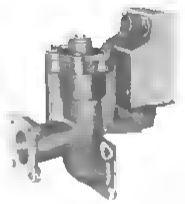

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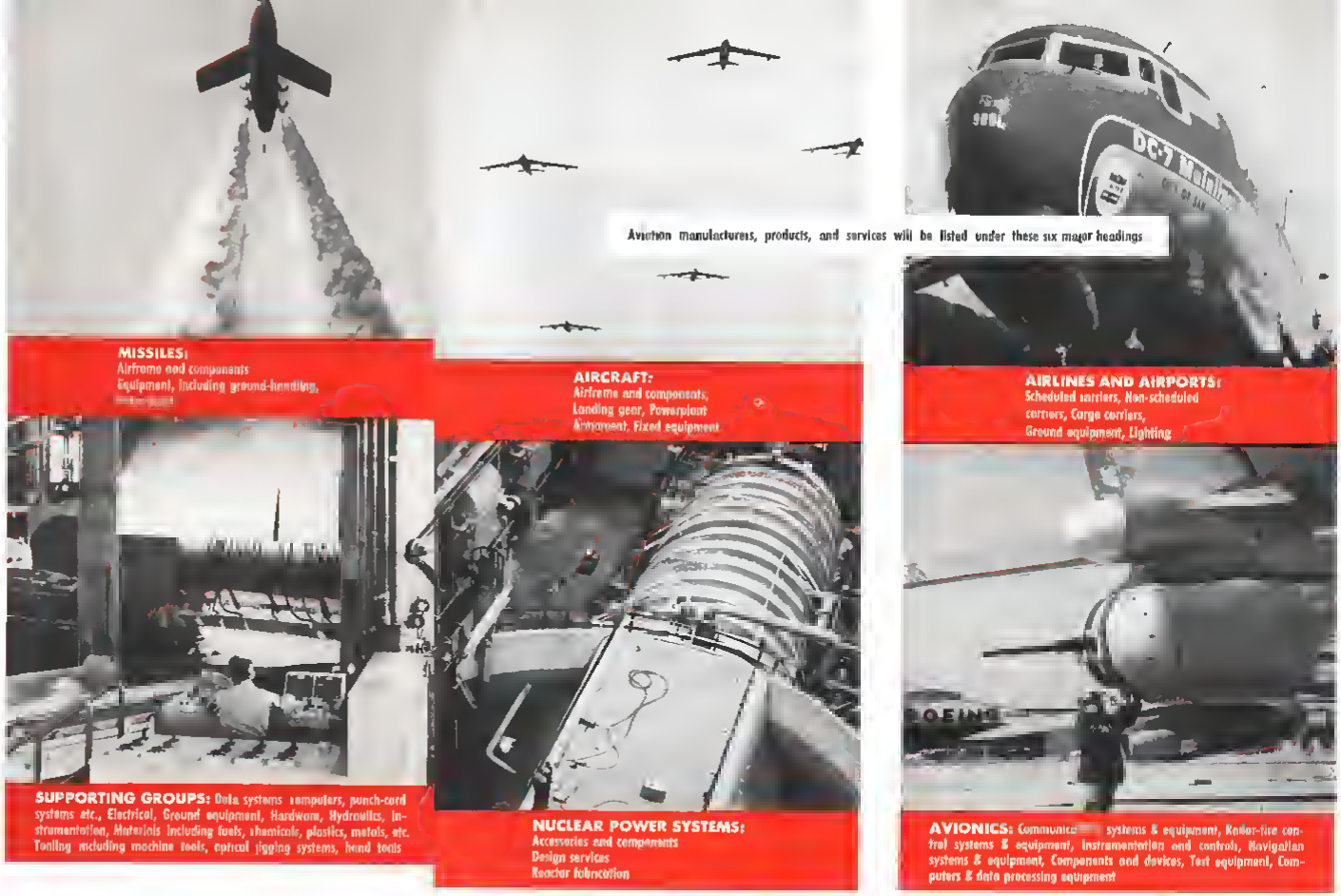

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feature of the recorder enabled determination of the elapsed time during and between transmissions.

Radar Advice

The radar controller located in the IFR rooms several floors below the tower cab, gave radar advisories to all flights making ILS approaches. The purpose of the advisories was to inform the flights of their positions as observed on radar relative to the glide slope, the localizer path and distance to touchdown. The advisories were given as a responsibility of the controller at various intervals during the progress of the approach.

A study of the recorded advisories was made as a phase of the investigation. Its purpose was an effort to reconstruct as accurately as possible the probable flight path of the aircraft during the last approach. (See sketch, page 57.)

Considered in conjunction with this study were the explanatory testimony of the radar controller, observations of two eyewitnesses, and testimony of surviving passengers.

It was learned that before instrument approach was started positive radio contact was established and flight had been given latest weather and altimeter information.

During the initial portion of the ILS approach radar contact was established and as the aircraft approached the four-miles-from-touchdown point it was observed to be somewhat to the right of the localizer path drifting left. Before reaching this position the flight was slightly left of course and lower than normal. During this time it was advised to maintain altitude, the flight continued to descend.

Below Glide Path

At approximately the three mile point the radar controller advised the flight that it appeared to be at 500 feet altitude and still descending. He then emphatically advised the pilot to level off.

While the aircraft approached the two mile point the controller advised the flight as follows, "Item Nan Easy level off, your altitude shows as 200 feet. About to intercept the glide path, 150 feet below glide path." In explanation of this advisory the controller stated that the flight descended to 200 feet, or lower, then it arrested the descent and began to climb.

Investigation disclosed that one of the eyewitnesses apparently observed this portion of the approach. His ground position was about 2½ miles from the touchdown point and nearly aligned with the localizer course. He testified that he saw the flight descend below the overcast to a low altitude, then sharply pull up and climb steeply back into the overcast. The witness did not recall the position of the landing gear.

The controller stated that as he observed the aircraft climbing he gave course information. Two miles from touchdown, 400 feet left of course, 300 feet left of course.

While he was offering this information the aircraft entered another descent to a very low altitude. He advised, "Your altitude is very, very low, pull up. Item Nan Easy pull up unless you have the runway in sight."

At this time the controller stated the

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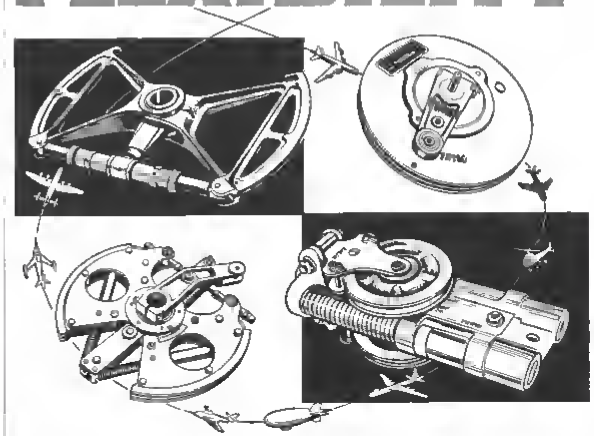

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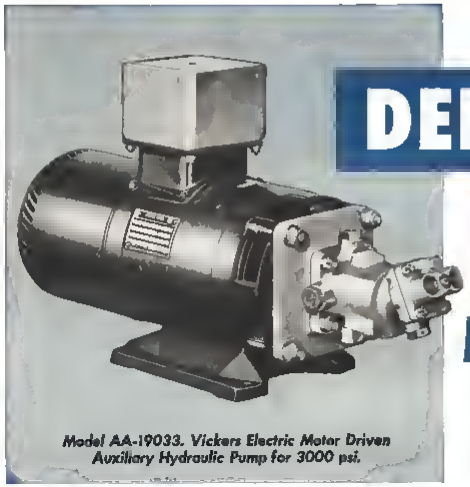

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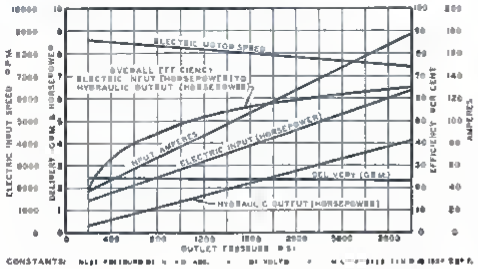

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aircraft began a sharp ascent turning right. The angle of ascent was decreased momentarily, then resumed. The climb continued until the aircraft was at or above the glide path altitude. At this time the controller believed the flight had begun a missed approach procedure and he continued: "Item Nan Easy I see you're pulling up, 500 feet left of course, a right turn heading 130 . . ."

The Crash

Upon reaching the peak of the climb the controller then observed the aircraft begin a sharp descent. He then advised, "If you have the runway in sight you're cleared to land." Observing the descent continue he added: "Item Nan Easy check the approach lights. Item Nan Easy you're very low on glide path." The controller saw the aircraft merge with the pier and heard a muffled explosion.

A second eyewitness, positioned approximately 1½ miles north of the approach end of runway 4, stated that he saw the aircraft descend below the overcast in what appeared to be a slightly steeper than normal nose-down attitude. He then saw the nose rise quickly to a nearly level position. He said the aircraft at this moment appeared to be slow and seemed to wobble. The aircraft continued to descend throughout his observations until he could no longer see it behind slightly higher terrain. Seconds later he heard a roar of the engines and almost simultaneously saw fire and smoke spout vertically upward. He then heard another roar of the engines.

The surviving passengers varied in their observations. All were in accord that the last approach seemed lower than the others and at one point there was a sensation of an extremely sharp pull up, followed by a sensation of a pitch down during which power was applied and galley equipment spilled down the cabin aisle. Three passengers, in positions enabling them to observe the main landing gear, stated that during the early portion of the last approach they were sure it was down. Weather conditions were poor and only fleeting glimpses of the water and swamp area could be seen.

One passenger seated on the right saw the right line of approach lights at an angle approximately 30 degrees and he guessed about 40 seconds transpired between this observation and the impact which followed.

Slope Line Lights

The approach lighting at the airport at the time of the accident was the slope line approach lighting system. It was installed and commissioned for use in 1949. This system provides two converging rows of bar lights, one row on each side of the centerline leading to the runway. The system is designed so the lights inform the pilot of his position.

The angle at which the lights are viewed informs him whether his position is left, right, or on the centerline to the runway and also whether his position is on above, or below the glide path. From any of these positions the lights are also designed to indicate the correction if necessary.

Officials of the Italian Airline testified

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that prior to the 1950 inaugural flight over the subject route many months were devoted to preparation for the forthcoming operation. Studies were made of the operating procedures and policies used by other airlines in their North Atlantic operations from which many features were adopted for the Italian flights. Visits were made for the purpose of examining the airports and facilities provided in the route and the most experienced flight personnel were selected for the operation.

Prior to the first flight several non-passenger trips were made under supervision of experienced North Atlantic flight crews of another airline. The operation into the United States was made in accordance with ICAO recommended standards incorporated in the Italian regulations.

Provision for Rest

Company officials testified that on a normal North Atlantic flight the captain and one of the other pilots would fly the aircraft to Shannon and then would rest during the Atlantic crossing while the other pilots flew the aircraft. After reaching the more congested areas of the United States the captain again would take the controls until the flight terminated.

This procedure afforded each pilot nearly equal rest periods. The bunks on board the aircraft provided them the best rest possible considering it would be under flight conditions and with continuing respective responsibilities for the flight.

Crew training was in most respects patterned after United States carrier programs. Investigation revealed the Italian program included ILS, instrument and GCA training. In many respects various training phases were given more time than the accepted standards.

No Language Difficulty

Company policy required that at least one member of the flight crew speak English fluently. The captain of Flight 451 was able to speak and understand English. A review of the recordings and transcriptions indicated that communications with 451 were conducted in a normal manner and no language difficulties were indicated. Transmission of messages and responses from the flight were prompt, and in accordance with standard practices.

Investigation revealed that the crew of the flight was qualified and experienced, the captain had made 150 flights over the Atlantic, 75 of which terminated at the New York International Airport.

Overall Weather

The synoptic weather situation when the flight left Gander consisted of a low pressure system centered over the Great Lakes with an occluded front extending to a secondary low over southern Virginia. This secondary center formed the junction of a warm front which extended east-northeast into the Atlantic ocean and a cold front that extended southward. This system was moving northeast and the position of the warm front was about 225 miles south of New York when the crew was briefed at Gander. This briefing indicated deterioration of the ceiling and visibility in the area ahead of the front

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as it moved northward.

Additional factors were a high pressure ridge off the east coast and a steepening pressure gradient between this ridge and the trough to the west. These factors indicated a rapid advection of air from the warmer ocean water northward over the coastal area. A cold low pressure trough aloft somewhat west of the surface trough resulted in a steep pressure gradient eastward into New England. This indicated a strong southwesterly flow to about 20,000 feet and an extensive lifting of warm air over the colder surface air north of the warm front.

At 0945, after the flight departed Boston, a special weather report for Idlewild was transmitted by Station WSY. The reported conditions were: Scattered clouds 1,500 feet, ceiling 7,000 feet overcast, visibility 1 mile, moderate rain and fog; wind south-southwest 23, gusts to 31. This report was received by the flight and copied in the flight radio log. At this time the warm front had progressed northward to approximately 100 miles south of New York City.

Investigation revealed that the crew did not receive a formal weather briefing at Boston as was customary for Italian Airlines crews, however, at 1015 the latest weather report for Idlewild was received from WSY and again copied by the flight.

Idlewild Weather

The reported conditions were: Ceiling measured 800 feet, broken clouds, 6,000 feet overcast, visibility 2 miles, light rain and fog; wind south-southeast 21 with gusts to 30. At this time the following terminal forecast was also broadcast: Ceiling 600 feet, overcast, visibility 2, light rain and fog; wind south-southeast 25 with gusts to 45, occasionally becoming ceiling 200 feet, overcast, visibility 1 mile, heavy rain and fog.

At approximately 1300 the warm front passed Idlewild with warm moist air flowing over a relatively cold land and water surface. The strong surface winds produced turbulent mixing and as a result rather definite ceilings of a few hundred feet with fairly good visibility were maintained.

After 1300 the surface wind velocity diminished somewhat. This resulted in less turbulent mixing in the lower layers and was reflected in a lowering of the reported ceiling to 200 feet overcast with 2½ miles visibility at the time of the accident.

Ceiling and visibility observations used in the reports for the Idlewild Airport incorporate the use of electronic equipment. Ceiling reports were based on ceilometer readings obtained from a rotating beam ceilometer located on the left inbound pier, at the accident site.

Visibility Report

Visibility observations were made from the Weather Bureau located approximately two miles from the accident scene. A transmissometer, an electronic means of measuring visibility, was located along runway 4 near the approach end, however this instrument, owing to its design, does not measure accurately when visibility is above 1½ miles. For this reason the instrument

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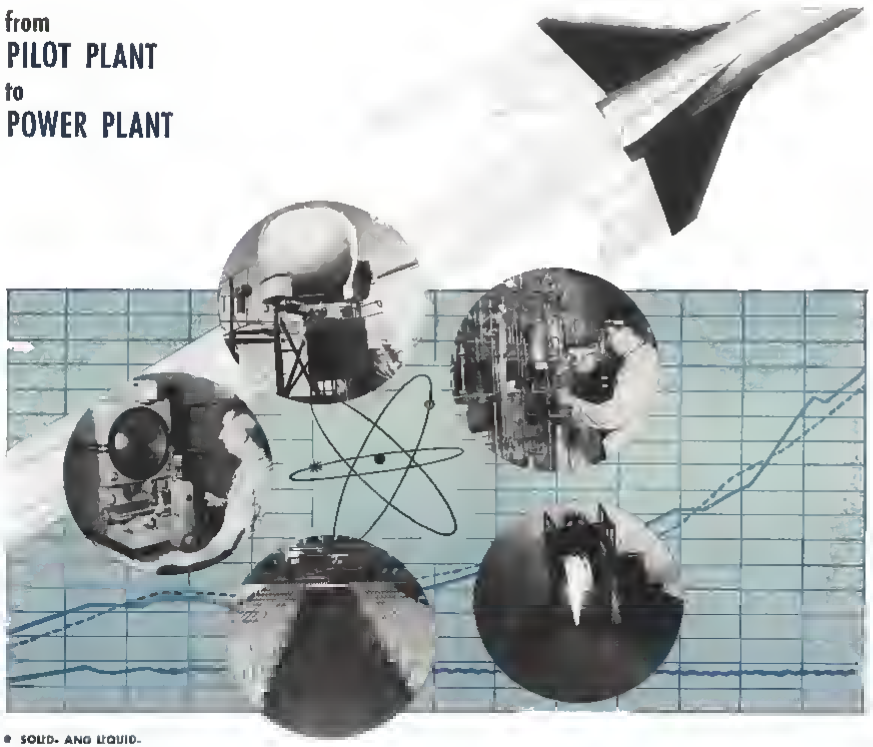

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was not used in observations during the accident period although it was operating. Investigation disclosed that during this time the transmissometer record continued to indicate more than ½ miles visibility.

Several airline captains who made ILS approaches and landings between the first and last approaches of the Italian flight stated that in the normal breakout area they found weather conditions equal to or better than reported. There was little turbulence and the bottom of the overcast was fairly well defined.

One captain stated however that conditions left of the localizer course seemed somewhat worse than reported.

Another captain the last to approach before the accident stated that when he was above and between the approach lights on the glide path he was unable to see them.

These witnesses also stated that while descending along the approach path there was a decided wind shift from left to right. This condition required commensurate drift corrections as the wind shift level was traversed. This factor according to these witnesses together with the eight knot downwind component was an important factor to contend with in a successful approach and landing.

Statements of these pilots confirmed the investigation which found the approach radio facilities operating normally.

Analysis

Weather conditions during the accident period were greatly influenced by the velocity of the surface wind. The resultant turbulent mixing probably kept the ceiling and visibility from deteriorating to near zero. After 1300 the wind velocity decreased somewhat and the effect was reflected in the subsequent reports.

Since electronic equipment for measuring the conditions was located at and near the accident site the reports were especially applicable to this area the normal breakout area during an ILS approach to runway 4. The general weather movement was from the off shore area over the measuring equipment. The reported conditions therefore should also have been quite representative of those immediately beyond the piers.

Still farther out along the approach path evidence indicates poorer conditions. Less turbulent mixing over the smoother water surface in this area lends credence to this possibility.

Troublesome Tailwind

During the first three approaches the crew adhered to the established minimum altitude and apparently maintained some margin above it.

The decision to discontinue these approaches was an exercise of the captain's judgment when he was not entirely satisfied to continue. It is believed that the tail wind component and wind shift encountered during the approaches to runway 4 were important factors which influenced these decisions. The tailwind component caused other airline flight crews some difficulty and one expressed it as "It made me feel I had done a day's work."

Although landings were being made downwind this was necessary because no other runway was equipped with ILS and weather conditions prevented the use of runway 22. This factor also probably caused the pilot to use a slower indicated airspeed during the last approach.

Not Following Path

Evidence indicates that on the last approach the pilot began a descent before intersecting the glide path and continued to descend although repeatedly advised by the radar controller to level off. Altitudes throughout the approach indicate the ILS glide path indicator would have shown a full scale fly up indication.

This evidence strongly suggests that the pilot was not attempting to follow the glide path but decided to descend until visual reference was established. The pilot apparently descended below the overcast in the area between the outer and middle markers probably in an attempt to proceed visually below the overcast to the runway. While attempting to do so however he may have encountered a drifting fog which was not recorded.

Such procedure is not in accord with good operating practice and the reasons for it in this instance have not been definitely ascertained.

When the aircraft broke out below the overcast in the vicinity of the outer marker, the pilot possibly saw the surface of the water and swamp without seeing the ap-

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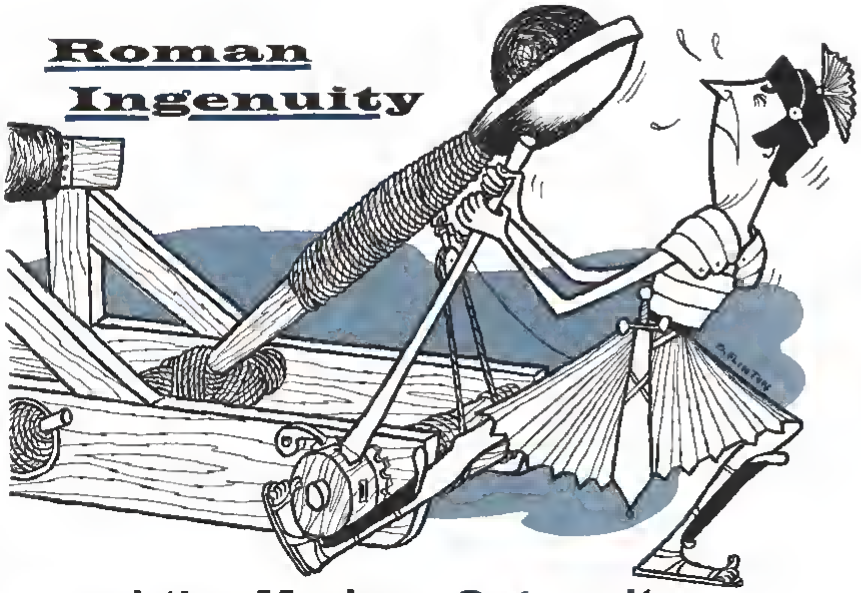

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proach lights and reacted quickly, pulling up into the overcast

Final Maneuvers

In order to arrest the ascent or again descend to establish visual contact it is believed the pilot lowered the nose of the aircraft and in so doing got very low. As a result he apparently again pulled up sharply, the aircraft drifting slightly left.

The ascent seemingly continued during which the aircraft lost airspeed and began turning right. The nose of the aircraft was then lowered and power was applied. The landing gear was probably retracted at some time during this series of events.

These movements of the aircraft are strongly supported by the testimony of the surviving passengers, the second eyewitness, and the path of the aircraft as observed by the radar controller.

The final descent obviously continued until the aircraft was a short distance from the pier but too close to avoid it.

During the Board's investigation and analysis of this accident careful consideration was given the possible misinterpretation of the approach lights or an illusion associated with them. Evidence regarding misinterpretation or illusion would be primarily the testimony of the crew. This was not available for consideration, the entire crew being fatally injured. The Board recognizes these as possible factors;* however from all the available evidence the Board was unable to determine whether or not the lights were a factor.

Fatigue Element

Although the entire crew was lost and actual rest periods are unknown there is no reason to believe that normal rest procedures were not followed. It is nevertheless believed fatigue was a factor in this accident. It was not only present as a result of the time en route, approximately 22½ hours, but mostly a result of the additional extended 2½ hour period devoted to the four approaches and the high mental and physical demands made upon the pilots.

The element of fatigue is strongly suggested especially during the last approach. Fatigue is evidenced by the pilot's poor adherence to the localizer path, the last descent to a very low altitude before the

*For discussion see Aviation Week issues of Jan. 31, Feb. 21 and Apr. 11, 1955. (This footnote was included as part of the official CAB report.)

Avionics Combats Fatigue

An automatic approach coupler in an autopilot-equipped airplane can greatly relieve the strain on a fatigued pilot and provide a more precise ILS approach under minimum weather conditions. Growing airline interest in the use of approach couplers will be described in next week's issue by Philip J. Klass, Aviation Week's Avionics Editor.

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...ing pull up and the evidence of abrupt control action. It may also be noted in some degree in the pilot's slow response to the wind shift and the probable loss of air speed which caused the sinking descent before the aircraft struck the pier.

These factors lend credence to the belief that the pilot's efficiency and normal ability were seriously impaired by fatigue.

Findings

On the basis of all available evidence the Board finds that:

1. The carrier, the aircraft and the crew were certificated by the Italian Government.
2. The carrier possesses a foreign air carrier permit issued by the Civil Aeronautics Board for the route.
3. The gross takeoff weight was less than maximum allowable at the departures over the route.
4. The aircraft departed Boston with fuel for approximately seven hours of flight.
5. No formal weather briefing was received at Boston, however the flight received adequate weather information en route.
6. The flight made four instrument approaches to the Idlewild Airport one to runway 22 and three to runway 4.
7. The three approaches to runway 4 were made with a downwind component approximating 8 knots.
8. There were no language difficulties between the flight crew and control personnel.
9. Prior to the last approach weather and altimeter information was given the flight.
10. The weather information was adequate for the normal ILS lineknot area.
11. Radio advisories were given the flight during the ILS approaches and during the last approach the flight was repeatedly advised that it was low with respect to normal ILS altitudes.
12. The last approach was apparently made without using the ILS glide path.
13. The radio navigational and landing facilities for the airport were functioning normally.
14. When the aircraft struck the pier it was nearly level laterally, slightly nose high, and without appreciable descent.
15. Approximately 80 percent of the wreckage was recovered, the examination of which revealed no structural or mechanical failure of the power units, propellers, airframe, controls, or instruments prior to impact.
16. The crew reported no mechanical or other difficulty.

Probable Cause

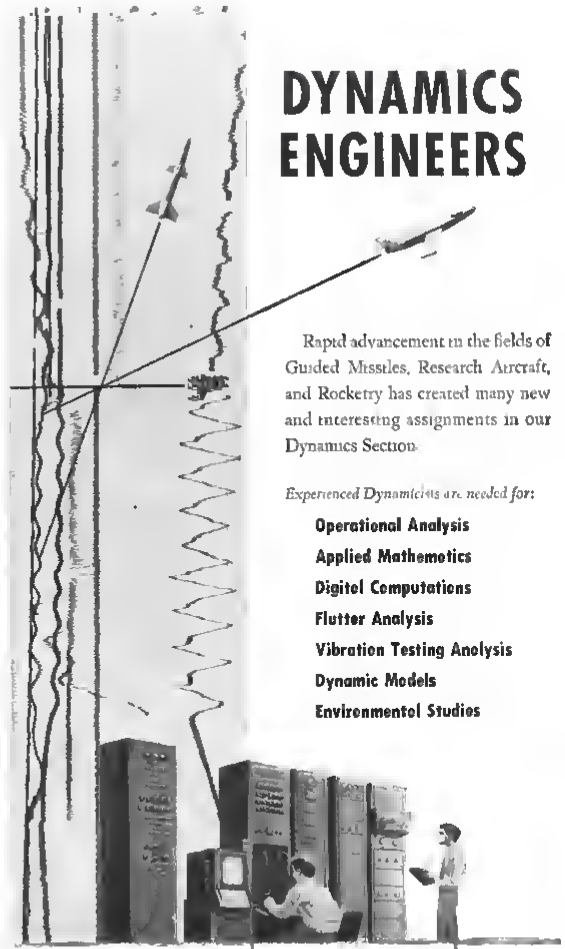
The Board determines that the probable cause of this accident was an erratic approach which resulted in a descent to an altitude too low to avoid striking the pier.

A contributing factor to this accident was pilot fatigue due to the particular and difficult circumstances.

By the Civil Aeronautics Board:

Ross Rizley
Joseph P. Adams
Josh Lee
Chan Gurney
Harmar D. Denny

DYNAMICS ENGINEERS



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WHO'S WHERE

(*Continued from page 9*)

Kenneth R. Meenen, chief of planning and operation of Piasecki Aircraft Corp., **Robert G. Kutzer,** assistant to the treasurer.

W. L. Stedman, manager of sales division of Central African Airways Corp. Other changes: **R. A. Weeden,** sales promotion manager; **A. B. Ginns,** Central Africa area sales manager.

George B. Meyer, Dayton defense products manager of Westinghouse Electric Corp. **Romus Soucek,** West Coast manager of defense products.

Frederick C. Bash, product manager of Atomic Frequency Standards Dept. of National Co., Inc., Malden, Mass.

Bertrand Y. Auger, technical director of reinforced plastics div. of Minnesota Mining & Manufacturing Co.

William M. Temple, manager of government sales, Libbey-Owens-Ford Glass Co.

Joseph Solan, general sales manager of components div., Federal Telephone & Radio Co.

W. C. Krane, Ontario sales manager of Dow Corning Silicones, Ltd.

Jesse M. Foltz, Jr., sales promotion & public relations director of Brown Line Corp., Beverly Hills, Calif. **Don L. Newton,** works manager.

M. D. Phelps, sales manager of Thompson & Co. **R. G. Henning,** assistant sales manager.

Leonard Griffith, chief of high pressure pneumatic group of Accessory Products Corp., Whittier, Calif.

A. D. Schultz, chief engineer of Stamping Div. of Eaton Manufacturing Co.

Dr. Harry G. Romig, staff engineer at Sunnen Gyroscope Co.

Abbot F. Stevens, advertising manager for Automotive and Machine Tool Divisions of Van Norman Co., Springfield, Mass. **John E. Mott,** general service manager for both divisions.

Perry C. Smith manager of equipment department of Brush Electronics Co., division of Clevite Corp. Smith formerly was general manager of Electronics Instruments Div. of Borroughs Corp.

Allen J. Dussault, general sales manager for Transitron Products Inc. **Samuel Rohinovitz** promoted to govt. sales manager.

Irving J. Minett general manager of Defense Operations Div. of Chrysler Corp.

James H. Landers Detroit sales office of Goodyear Aircraft Corp.

Harvey T. Hamod manager of government contract administration for Westinghouse Electronic Tube Div.

William J. Pierre, purchasing director of Kaydon Engineering Corp. **Harold R. Marquand,** industrial relations director, **Harry C. Waters,** assistant treasurer.

Dr. James H. Gardner technical assistant to research director of National Research Corp.

George F. Sharrard, director of research and development of R. M. Hollingshead Corp.

George D. Butler, sales director of Norden-Ketay Corp. Butler was vice president of sales at Warren Electronics, Inc.

Ray L. Vroome, sales manager and administrator of government contracts of Colvin Laboratories, Inc.

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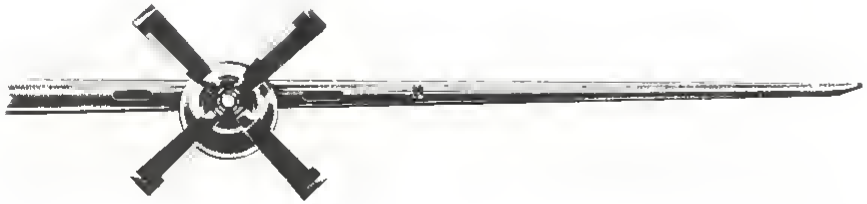

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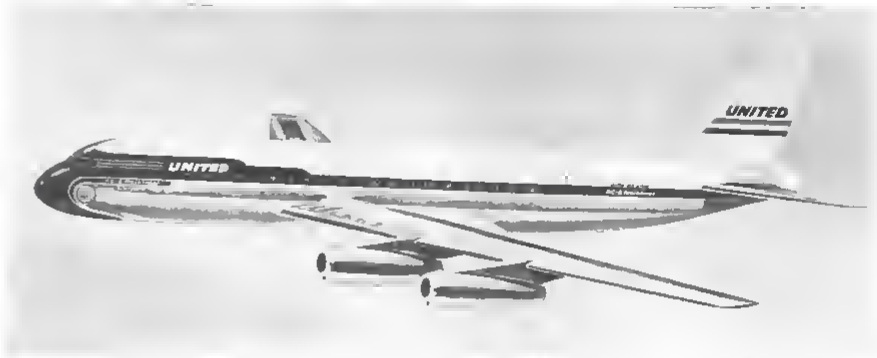


LATE IN 1959 UAL'S DC 8S will fly 112 first class or 140 coach passengers on U S and Hawaii routes at 550 575 mph speeds.

United Orders 30 Douglas DC-8 Jets

By Craig Lewis

United Air Lines became the first domestic carrier to order turbojet transports with a $175 million order for 30 Douglas DC 8s

Delivery of the new turbojet transports is scheduled to begin in May, 1959, and United plans to inaugurate service over its transcontinental and Hawaiian system the following November

With the United contract Douglas Aircraft Co now has orders totaling $335 million for 55 DC 8s Pan American World Airways ordered 25 of the transports earlier this month (AW Oct. 17, p. 7), along with 20 Boeing 707s

The United DC 8 will be powered by four Pratt & Whitney J57 turbojet engines, each rated at more than 10 000 lb thrust The airline says the J57s will cost $145,000 each

Range Over 3,000 Miles

The cabin configuration for the United DC-8 will accommodate 112 first class or 140 coach passengers It will also carry 7,000 lb. of mail, express and freight and a fuel load of about 15,500 gallons Gross weight will be 242,500 lbs , and range over 3,000 miles

The United turbojet transport will cruise at 550 to 575 mph between 30,000 and 40,000 feet A new pressurization system is designed to keep cabin pressure at sea level up to 23,000 feet and at 5,000 feet at an actual altitude of 34,000 feet

All of the new jet aircraft will be equipped with C-Band radar

United announced that its DC-8s will be equipped with a thrust-reverse mechanism to cut landing distances A program is also under way to cut much of the external noise from the turbojet engines

W A Patterson, UAL president, said that one device has already been tested which reduced noise considerably and that other developments assure a noise level materially lower than that of any current multi-engine jet aircraft

Douglas plans to fly its first DC-8 early in 1958 and the transport is expected to be certified by the Civil Aeronautics Administration by the fall of 1959 in time for United to start service in November Douglas has applied for type certification and has informed the CAA there will be two versions of the DC 8 for domestic and international operations Maximum gross weight will be 257,000 lb

Pan American, which placed its DC-8 order before United, will take aircraft starting in December, 1959 Pan American has ordered the overseas version and will have to wait for the more powerful Pratt & Whitney J75 engine for its aircraft

A CAA official will visit Douglas in Santa Monica this week to begin the type certification process, and an engineering group will be at the Douglas plant in December

Patterson said that United has been consulting with aircraft manufacturers for five years in preparing to buy a turbojet transport and that operational studies were made in a year long 'Paper Jet' project at San Francisco which was started in 1953

Jet Economies

"Our studies conclusively indicate," Patterson said, 'that on the basis of present day costs, the per seat mile cost of operating the jet plane will be less than that for our latest type piston powered aircraft This, combined with the traffic volume expected to be generated by the greater speed and comfort of the jet, will assure us of the profits necessary to support this

Typical DC-8 Times Between Major Cities

	Mileage	Expected Jet Time Hours	Present Best Time Hours
Los Angeles-New York	2,469	4½	7½
Los Angeles-Chicago	1,751	3½	5½
Chicago New York	724	1½	2½
San Francisco-New York	2 580	4½	7½
San Francisco-Chicago	1,856	3½	5½
Honolulu-San Francisco	2,400	4½	7½
Honolulu Los Angeles	2,558	5	8¾

large new investment in aircraft"

United built a full-scale mockup of a jet airliner at its San Francisco maintenance base to use in planning cabin configurations and installations.

For six months, the airline has had a management and technical team working full time on all aspects of turbojet operations, maintenance and service. United says the group expects the DC-6 to have greater dependability than any previous airplane.

Patterson announced that a financing program is now being arranged to pay for the DC-8s.

Unions in Conflict Over United Strike

A flight engineers strike called against United Air Lines has resulted in a family squabble among American Federation of Labor unions.

The flight engineers struck United October 23, but the airline continued to operate with pilots filling the flight engineer assignment on DC-6 and DC-7 equipment. By the middle of last week, United said that only about 5% of its schedules had been disrupted by the strike.

Other AFL unions decided not to support the Flight Engineers International Assn. in its fight with United. The Air Line Pilots Assn. said its members would continue to fly because the engineer strike was an attempt to set pre-employment standards, and the net result would be to tend to confuse authority in the cockpit. ALPA doesn't agree that United's plan to hire engineers who are pilots threatens engineer's job security.

George Meany, AFL president, accused ALPA of "collusion" with the airline in letting its pilot members replace flight engineers. Meany said ALPA's action is in violation of trade union principles and noted that it could result in expulsion from AFL.

Job security is the issue the union struck on. All other items in the contract, which has been under negotiation since February, were settled, but the company and the union couldn't agree on the security provisions, even with the help of federal mediation. The engineers struck 15 hours after the mediation period expired.

The union wanted various job security clauses included in the United contract which the airline considers unreasonable. United said that the engineers want the guarantee of an assignment on any new type of aircraft the airline might operate, and the airline refuses to give such a guarantee.

A major point of contention between the union and the airline is United's policy of hiring engineers which are also qualified pilots.

American, United and Western Report 9-Month Revenue Gains

Trunk airlines are reporting big traffic and financial gains in the first nine months of this year.

American Airlines, United Air Lines and Western Air Lines have all recorded substantial increases in operating revenues and net earnings for the first three quarters of 1955.

American Airlines

American reports net earnings of $14,337,000 for the nine months on operating revenues of $194,895,000. Earnings for the same period last year were $5,466,000 including profit after taxes of $1,126,000 on the sale of aircraft and engines, and revenues were $154,481,000.

Revenues and earnings for the first three quarters of 1954 were affected by a pilot strike in August which caused a loss after taxes of $2,790,000.

Earnings for the 1955 nine month period amount to $1.88 a common share after preferred dividends, compared with 68 cents a share for the same 1954 period.

In the first three quarters American carried 5,473,000 passengers 3,267,000,000 revenue passenger-miles, an increase of 30% over the same period last year. Cargo traffic for the nine months was 49,669,000 ton-miles, 31.5% more than last year.

United Air Lines

United had record earnings of $10,011,309 for the first nine months of 1955, compared with $8,433,683 for the 1954 period. Revenues were $179,269,786 for the first three quarters of 1955 and $148,166,395 for the same period last year.

United's traffic and revenues for 1954 were affected by the American pilot strike, which resulted in abnormally high traffic for United during the August interruption of American's operations.

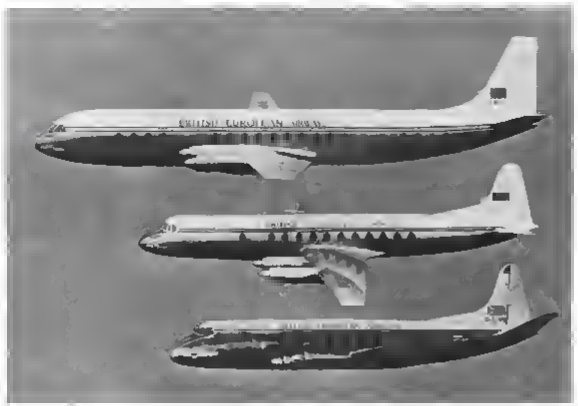
Earnings for the first nine months of this year amounted to $3.56 a share of common stock, compared with $3.13 a share for the same period last year.

United flew 3,054,512,235 revenue passenger-miles in the period, compared with 2,464,741,783 passengers miles for the 1954 period. Mail traffic increased 15%, express traffic 23% and freight traffic 27.5% in the first nine months of 1955.

Western estimates record earnings of $1,600,000 for the first nine months of 1955, a 55% increase over earnings of $1,037,000 for the same period of 1954. The earnings represent net income of $2.15 a share, compared with $1.45 a share for the 1954 period.

Operating revenue for the first three quarters was $23,100,000, a 28% increase over 1954 revenues for the same period.

Western declared a regular quarterly dividend of 15 cents a share, plus a special dividend of 15 cents a share, bringing the total 1955 payment to Western shareholders to 90 cents a share, compared with a 60 cent total in 1954.



Three Stages in BEA Turboprop Operations

British European Airways' present and future transport operations are symbolized in this view showing three Vickers Armstrongs turboprop airliners to the same scale. At bottom is 59-passenger Viscount now being operated by the carrier; in the center is a model of the 65-passenger development of the Viscount ordered by BEA and at top is a model of Vickers' latest turboprop, the 93-passenger Vanguard. 20 to 25 of which were recently ordered by the airline (AW Oct. 24, p. 12). The two newer transports represent BEA equipment plans well into the 1960s. Initial developments of the Rolls Royce RB 109 engine will give the Vanguard a 400-mph. cruise speed. Later models will cruise at 425.

CAA Plans Symposium On Collision Hazards

Eight industry and government agencies are scheduled to report on their experiences with mid-air collision hazards at a symposium sponsored by the Civil Aeronautics Administration at Indianapolis on Nov. 8 and 9.

The participants in the mid-air collisions symposium all are engaged in "anti-collision" activities and will describe their efforts and results of test programs involving basic aspects of the problem. The meeting will be under the direction of the Technical Development and Evaluation Center of CAA at Indianapolis with the cooperation of the Illuminating Engineering Society.

M. G. "Dan" Beard, assistant vice president of American Airlines in charge of equipment development, will be chairman of all sessions with Melvin N. Gough, chief of the Flight Research Division of NACA, as moderator, and Donald M. Stuart, director of CAA's TDEC, in charge of local Indianapolis matters.

Demonstration of new devices, including lights for use in daylight and darkness, will be part of the symposium. A night demonstration of eight types of new lights for night use will be given on Nov. 8 to be followed by a demonstration of lights for daylight the next day. There will be an inspection of various anti-collision devices under test by the TDEC at the Indianapolis municipal airport.

Speakers will include Dr. Walter F. Grether, Wright Field, on human scanning habits; Capt. Norman L. Barr, Naval Medical Institute, on atmospheric visibility; Col. George O. Emerson, Wright Field, on the effect of the retinal blind spot; Maurice L. Laufer, Grumes Mfg. Co., on requirements of aircraft position lights; Thomas M. Edwards, TDEC, on conspicuity in flight; and Dr. Clifford Seitz, Navy Special Devices Center, on general psychological problems of pilots. The talks will be followed by general discussion.

Sikorsky 35-Passenger Helicopter May Be Ready for Airlines in 1959

By Alpheus W. Jessup

Bridgeport—The twin-engined 35-passenger Sikorsky S-56 helicopter should be available for airline and industrial operators in 1959 or 1960, according to J. E. Beighle, sales manager for the Sikorsky Division of United Aircraft Corp.

Provided turbine engine development is adequate, Beighle believes the S-56 will be an economical transport. Military versions are now powered by two Pratt & Whitney R2800 engines, delivering 2,200 hp. each. Replacement with an engine like the Allison T56 derated from its maximum of 3,750 eshp. to 3,000 or 3,200 eshp. will greatly increase single engine performance, as well as overall operational efficiency.

The commercial S-56 with turbine power plants probably will have a considerably increased payload over the three-ton capacity of present military ships. The structural weight of the latter is increased considerably by the military demand that their version of the S-56 carry its load on two cargo bearing points.

Civil versions would have a much wider load distribution, requiring lighter construction and increasing useful load.

S-58 Power Train

Meanwhile, Beighle foresees several years of commercial orders for the S-58, which was recently ordered by New York Airways. Now built for a gross weight of 12,600, including a useful load of 5,070 lbs., the S-58 has a growth potential to a gross of 15,000 to 16,000 lb., a large portion of which would be in payload and passenger capacity (now 12).

The heart of the S-58 is its power train and control system. This was designed for the larger gross. All that is needed now is a more powerful engine than the Wright Cyclone C9 (R1820-84), which has maximum output of 1,525 hp.

Sikorsky says the turbine engine is the ideal helicopter power source. The company is working on a twin turbine installation for the S-56. Presumably this is a configuration using two Lycoming T53s, or similar engines, which develop 800 hp. each.

In addition, of course, a new fuselage would be required to provide space for the additional seats or freight loads the added power would make possible. This is neither a difficult nor time consuming process, according to Beighle.

Beighle believes that operation of the S-58 by New York Airways can be started next year without any increase in the helicopter airline's subsidy. And it is expected that the subsidy needs will begin decreasing shortly. Once this has happened, it is hoped that the Civil Aeronautics Board will consider granting certificates to helicopter airlines for other major municipal centers.

Only when this happens will turbine helicopter expansion take place in this country unless civil defense requirements speed up the expansion.

In the recent New England flood disasters, helicopters demonstrated their usefulness under rescue conditions that came close to duplicating those which would be presented by a nuclear attack on a U. S. city. In a review of rescues of some 400 persons made by its own helicopter crews, Sikorsky figures that about half could not have been rescued by other means and would have lost their lives.

Los Angeles Airways is not expected to buy S-58s until next year. Now, operating S-55s, it has high load fac-

NEW SIKORSKY PLANT in Stratford where S-56 will be built includes 800,000 sq. ft. of floor space about 630,000 of which is being utilized for direct production. Hangar is at right rear corner, beyond it is landing strip and helicopter pads.

tors on its long haul routes and is carrying a high volume of mail. Both factors are making for an economical operation with the S-55.

Foreign Interest

Foreign interest in the S-58 is high. Twelve countries have begun negotiations. Four have almost firmed up orders for 50 aircraft. India has asked Sikorsky to help it dispose of the S-55s bought last year so that it can buy the S-58.

Last week, Sikorsky dedicated its new plant at nearby Stratford, Conn., where it is building S-55s and will build the S-56. When fully equipped and at peak production next year, the plant will employ 4,000 persons. The Bridgeport facility is exclusively devoted to manufacture of the S-58.

Board Would Reduce Subsidy for Braniff

Sharp reductions in subsidy for Braniff Airways have been proposed by the Civil Aeronautics Board in the first mail rate decision reached under the offset principle.

The CAB proposes to apply earnings of Braniff's domestic operations to offset international deficits and cut the carrier's mail pay by more than half the 1954 figure. This is the first application of the principle set by the Supreme Court in the Chicago and Southern case.

Under the tentative rate decision, Braniff's subsidy for 1955 is forecast at $386,000. The annual subsidy forecast for future years is $979,000. This means a reduction of $2.7 million for a normal future year.

The 1955 subsidy is a $3.3 million reduction from the $3,755,153 reported for 1954.

This year's subsidy is lower than future periods because of an abnormal tax situation caused by an accelerated depreciation program which ended August 31, 1955.

Under the new rates, Braniff's domestic operations, which required $1,436,000 in subsidy last year, will be subsidy free. The carrier's domestic earnings in excess of 8% return on investment will be used to reduce subsidy requirements for international operations.

Eight Airlines Sign Pact With New York Airways

New York Airways announced last week that it has signed agreements with eight national and international airlines to provide their passengers with connecting helicopter service between New York International, LaGuardia and Newark Airports beginning Nov. 1. A similar joint fare agreement has been in effect with Northwest Airlines for the last several months.

The first of the new airlines to announce its agreement to the plan, which is still subject to Civil Aeronautics Board approval, was Pan American World Airways (AW Oct. 10, p. 115). Those announced last week:

- **Trans World Airways.**
- **Air France.**
- **British Overseas Airways Corp.**
- **KLM Royal Dutch Airlines.**
- **Sabena Belgian World Airlines.**
- **Scandinavian Airlines System.**
- **Swissair.**

Under the agreement, all international transit passengers carried by the airlines will pay no extra charge for the helicopter service between the three airports.

All international originating or terminating passengers, however, will pay $3.00 (before taxes) for the flight between LaGuardia and New York International and $5.00 between Newark and Idlewild.

Robert L. Cummings, New York Airways president, said in announcing the agreements that his company has now reached one of its "principal objectives—(to) become an adjunct of the fixed wing airlines of the world."

Cummings also reported that his helicopter line is now carrying approximately 3,000 passengers each month.

New and Future IATA Presidents

Lord Douglas of Kirtleside, British European Airways chairman (left), greets Juan Trippe, PAA president and new president of the International Air Transport Assn. during their recent meeting in New York. Looking on is Sir William Hildred, IATA director general. Lord Douglas is the president elect of IATA and will take office during the 1956 annual meeting of the International Airline Association which is scheduled to convene in Edinburgh, Scotland. Juan Trippe received the gavel as IATA president for 1955 during IATA's annual meeting in New York at the Waldorf-Astoria Hotel (AW Oct. 24, p. 106). His keynote speech invited the Soviet airline, Aeroflot, to join IATA.

EAL-Colonial Merger Approved by Examiner

The Eastern Air Lines-Colonial Airlines merger agreement has been approved by Civil Aeronautics Board examiner Herbert K. Bryan.

The examiner found that acquisition of Colonial by Eastern is in the public interest and should be approved by the CAB.

He also found that Eastern has offered a reasonable price for Colonial's assets.

Under the acquisition plan, signed last January, Eastern would acquire Colonial's assets in exchange for Eastern stock.

President Eisenhower turned down the original Eastern-Colonial merger agreement after the CAB approved it when he found Eastern had illegally gained control of Colonial prior to the agreement.

In a subsequent investigation, the CAB found that Eastern had divested itself of control.

The examiner recommends that assets taken over by Eastern should be entered on Eastern's books at the book value on the date of transfer and that the agreement be subject to labor protective provisions.

CAB ORDERS

(Oct. 13 to Oct. 19)

GRANTED

Capital Airlines an exemption to provide free transportation to two technical representatives of Rotol limited for in-flight observation, for six months.

Western Air Lines leave to intervene in the Bonanza Air Lines permanent certification case.

Central Airlines an exemption to serve Sherman Denison, Texas on Segment 2 and Segment 3 of Route 81 for one year.

Leave to intervene in the Eastern Air Lines route consolidation case to the Charleston Chamber of Commerce and the County Court of Kanawha County, W. Va., the city of Memphis, Tenn. the Memphis Chamber of Commerce and the Owensboro-Davies County Airport Board.

APPROVED

Interlocking relationships between John G. McKay, Jr., Riddle Airlines and Embry-Riddle Co., and between Charles A. Hinsch, Riddle Airlines and Queen City Flying Service.

Agreements involving United Air Lines, Colonial Airlines and various other carriers relating to intercompany arrangements.

Los Angeles Airways' Revision No. 39 of its flight pattern, originally approved July 8, 1955, for an indefinite period from October 18, 1955.

ORDERED

Ozark Air Lines to show cause why its temporary mail rate should not be set at a rate sufficient to provide a breakeven need of $2,027,342 for the year starting Aug. 9, 1955.

Mohawk Airlines authorization to omit certain services at Auburn/Geneva, N. Y., Rochester, Syracuse, Ithaca, Binghamton/Endicott/Johnson City and Elmira/Corning and to conduct nonstop service between Ithaca and New York/Newark and between Elmira/Corning and New York/Newark.

Applications of Eastern Air Lines, National Airlines and Southern Airways and the petition of the city of Dothan, Ala., consolidated with the Panama City, Fla.-Atlanta investigation. Leave to intervene in the case is granted to Delta Air Lines, the city of Albany, Ga., and the Albany Chamber of Commerce.

Application of the City of Lancaster, Pa., for north-south service reinstated.

California Air Charter letter of registration suspended for failure to file certain reports unless the reports are filed by Oct. 27, 1955.

DISMISSED

Flying Tiger Lines application for an exemption to perform a flight from Hamburg to New York pursuant to a contract with the Rector Shipping Co., at the request of the applicant.

Flying Tiger Line's application for an exemption to perform certain charter flights since the termination date has passed and the application is moot.

Alaska Airlines' complaint against a Pan American World Airways proposal to reduce roundtrip rates between Seattle and Nome, Alaska, since the complaint doesn't

Traffic Control—Airline Insurance

It has been rumored that an airline vice-president was once seen reading this column.

Now, if he should read this particular one, I would like to ask that Veep if he would please pass this on to the Prexy—for this is a high-level proposition. Specifically, aviation is in great need of some high-level airline know-how work on an insurance program.

In about five years the airline business is going to be in the throes of the greatest airborne revolution since the Montgolfier Brothers stopped playing around with hot air balloons. And with all this high priced equipment buzzing around the skies, certain problems that are with us now will surely be magnified. Traffic control will be one of these. And this is where insurance comes in.

It seems logical that if the airline industry has enough faith in the growth of air travel to mortgage itself for untold millions it should have the wisdom to take every step to insure that these airplanes will keep flying. Remember, if they sit on the ground they just aren't going to pay for themselves. And without a good traffic control system—far better than we have now—some of this high priced machinery will fall prey to unpremeditated idleness.

Costs of Poor Control

Under present day conditions it is a fact that many flights on the high-density routes (and all routes may be high-density someday) are cancelled for pure traffic control reasons—in weather that is perfectly flyable. The beasts which are coming off the drawing boards now will be even more susceptible to this illness. They will be more critical concerning fuel and will need greater assurances of expeditious landing clearances.

Aside from the weather problems there is the high-density problem itself. As speeds go up (and sometimes windshield area down) and climbing angles get even steeper to reach higher altitudes, the VFR collision menace grows. It is almost a certainty that the day is coming when uncontrolled flight will be a thing of the past. It simply will not be safe to fly on a see and be seen basis. So we need a system which can handle traffic on a come what may, 24-hour-a day basis, regardless of weather.

How does this concern the president and chairman of the board? Simple. They must seriously consider allocating some super smart v.p.'s and what ever money is necessary to work on the problem of 'keeping 'em flying. Oh, I don't mean designing hardware or systems or such. There are lots of smart people who can work on those problems. But they have to know what to plan for.

What Will Future Bring?

So from the airlines we need 'what," not the 'how." What will airline requirements be in 10 years, in 20 years? What special aircraft characteristics will need catering to? What equipment will airlines be willing to install in these aircraft? Some of these may be "crystal ball items,' but we need some information with which to start. And furthermore, we need some rather firm answers so that the planning will be correct. We won't be able to change traffic control systems every time a new airplane comes out or another schedule is added.

Like all natural resources airspace is valuable. It must be used more wisely than heretofore or else there will be a severe shortage. Everyone who has a stake in aviation has a stake in traffic control. And the airlines are one group who must take this subject seriously and lend top level support.

OPERATIONS ENGINEERS

Concurrent with the establishment of a Military Relations Department at the Fairchild Aircraft Division, an Operations Engineering organization has been established. The purpose of this new group is to provide technical information for use by Fairchild Military Relations representatives, as well as by personnel in Fairchild's engineering departments. This new group will conduct studies on specific Fairchild airplanes, as well as systems studies relating to possible future Fairchild developments.

The scope of this organization is such that additional engineers are required in the following fields

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state facts which warrant suspension, investigation or other action.

DENIED

Frontier Airlines' motion for consolidation of its application for a Silver City-Albuquerque extension with the case involving designation of Tucson, Ariz. as an intermediate point on Route 2. Leave to intervene in the case is granted to American Airlines, Frontier Airlines and the city of Kansas City, and Trans World Airlines is made a formal party to the proceeding.

Eastern Air Lines' petition for reconsideration of Board action denying an earlier Eastern petition in the Mackey airlines renewal case.

Eastern Air Lines' motion for consolidation of certain Eastern applications with the New York-Florida case.

SHORTLINES

▶ **Air France's** first two 1649 Super Constellations will have RCA X-Band radar equipment which the carrier will use in an operational study.

▶ **Allegheny Airlines** flew 5,449,000 passenger miles in September, an increase of 41% over September 1954. Traffic in the first nine months of 1955 was 42,248,000 passenger miles.

▶ **British European Airways** will continue its helicopter service from central London to London Airport through the winter with a schedule of four round trip flights daily. The service has been operating with a 71% load factor.

▶ **British Overseas Airways Corporation** has added another flight to its all freight service between London and the Far East. Cargo flights now leave London Sunday and Thursday and connect at Singapore with services to Australia.

▶ **KLM Royal Dutch Airlines** have inaugurated a Pay Later Plan for travelers from The Netherlands and Belgium. The minimum fare under the plan is $52, with 15% down and up to 12 months to pay the balance at 9% per year.

▶ **Ozark Air Lines** started service to Owensboro and Louisville, Ky. October 21. Two round trips will be operated daily between Paducah and Louisville via Owensboro.

▶ **United Air Lines** plans to offer alternate routings to transcontinental passengers traveling on the new excursion fare. UAL has scheduled nonstop services from the Pacific Northwest to Chicago starting October 31. The DC-7 service between Portland and Chicago is 5¼ hours and 6¼ hours from Seattle-Tacoma to Chicago.

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■ **PROJECT LEADER—DATA PROCESSING**—Supervise project activities involving radar video processing equipment (analog and digital). BSEE, 10 to 15 years' experience in development and design of electronic equipment (5 years' project direction). Experience with communication equipment desirable.

■ **PROJECT ENGINEER**—Prepare comprehensive engineering reports by consultation with development engineers. BSEE, 5 years' experience in design and evaluation of electronic equipment, plus several years in the preparation of engineering reports and manuals. Knowledge of radar fire control desirable.

■ **PROJECT LEADER—FIRE CONTROL**—Technically lead a fire control project. BSEE, 10 years' electronic experience, including design, development, organization and technical direction of major projects (5 years in fire control, including tactical and control displays and human engineering). Radars and data extrapolation experience desired.

■ **PROJECT ENGINEER—ANALOG COMPUTER**—Assume project responsibility and technically direct major portions of a fire control analog computer project. BSEE, 10 years' experience in electronics, including design, development, organization and technical direction of major projects, 4 years' experience in design and development of analog computers required.

■ **SYSTEMS ENGINEER**—Experience in broad systems design or definite indication of promise is essential. BSEE, 8 to 12 years' experience in electronics of radar and guided missile systems; 5 years in design and development of radar and electronic circuitry required.

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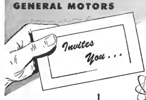

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Secrecy Stifles Progress

There is a growing realization in top level military circles that the super secrecy of current security policies is responsible for stretching out the development cycle of new military equipment. Military security policies are so stringent that they have in a large measure prevented the free flow of new scientific information among the technicians and engineers who were expected to spur development of new weapons and have prevented top level industry management from knowing enough about military requirements to guide their firms along sound technical lines on long range projects.

At the same time it is evident that the security clamps on technical information did not prevent many of our top technical secrets from leaking to the Russians. Nor did these security policies stop the Russians from overcoming much of our technical lead in atomic weapons and high speed jet aircraft. Events of the past five years have made it clear that the technical security program of the Pentagon has been a miserable failure and that it has hampered swift development of new American weapons more than it has hindered the Russians.

Lyman's Warning

Last week we listened to Lauren D. Lyman, a former New York Times Pulitzer prize winner, vice president of United Aircraft Corp. and highly respected as one of the elder statesmen of the aircraft industry, point out many of the things we have cited above to a military industry audience at the Aero Club of Washington. Lyman warned that a democratic society cannot survive on a "need to know" philosophy that eventually creates an intellectual aristocracy and deprives the citizenry of the information they need to make the intelligent decisions necessary to insure survival. Lyman also warned bluntly that the development of commercial aviation so vital to both our military strength and our civilian economy is being seriously retarded by unrealistic military security regulations.

We recently had a shocking experience when the first public information was released last month on Richard Whitcomb's development of the area rule at NACA's Langley Laboratory. This information was distributed to the aircraft industry on a confidential basis in September 1952 and it was applied promptly to two specific new supersonic prototypes. It got into one of these planes largely through personal contact of the company engineers with NACA staff men and into the other because the firm's engineers were in deep trouble on that particular aircraft and were beating the technical bushes for possible solutions.

When AVIATION WEEK recently published the first complete details on the area rule we were swamped with inquiries from aircraft industry engineers who had obviously never heard of the Whitcomb work or NACA's confidential report. Top tier engineers from one air frame firm, well known for their excellent fighters, expressed skepticism and in fact thought the Whitcomb work was actually nothing more than the German Kuchemann's "Coke Bottle" configuration of 1945. This experience clearly indicates that the distribution of new technical information among the engineering and scientific community in the aircraft and related industries is utterly inadequate and needs serious study.

Who Is Helped?

AVIATION WEEK refrained from publishing the area rule story for 18 months after we originally obtained it because of security considerations outlined by the highly respected director of NACA. It may be true that we kept the area rule information from the Russians for 18 critical months but we now wonder if we didn't also keep it from the bulk of engineers in the American aircraft industry.

The Air Force is now realizing that it has been paying a prohibitively high price for its super-security. Its Air Research and Development Command under the leadership of Lt. Gen. Thomas Power is tackling this problem in a realistic manner. Plans have already been made (AW Oct. 17, p. 12) to release the secret USAF technical planning studies to a selected list of 100 top contractors working on new aerial weapons systems.

Details Next Week

The aircraft and avionics industry leaders will get full details of this program at an Institute of Aeronautical Sciences meeting in Dayton next Wednesday. ARDC is also sponsoring a series of military industry symposiums on the critical technical problems of the hour to stimulate better communications between engineers and scientists working in related fields.

The ARDC program is important because it will remove some of the secrecy shackles that have prevented the aircraft and avionics industries from making as full and fast a contribution as the current technological race with Russia requires. It is a program that should be studied and applied by every government agency concerned with technical development.

—Robert Hotz

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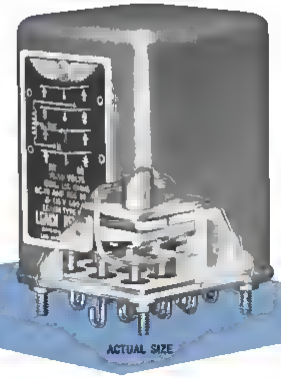

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